COMPLETE

CRIME SCENE INVESTIGATION

WORKBOOK

EVERETT BAXTER, JR.

CRC Press
Taylor & Francis Group

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CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

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Version Date: 20150413

International Standard Book Number-13: 978-1-4987-0143-3 (eBook - PDF)

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Preface

As a working crime scene investigator, I have had the opportunity to process a wide variety of crime scenes, from the simplest scenes that contained a single cartridge casing to complex scenes drenched in horrific detail. Processing any crime scene—simple or complex—involves many technical aspects. If the evidence is not properly documented, handled, and packaged, its true meaning may be lost forever.

A well-trained crime scene investigator should be knowledgeable in every aspect of crime scene investigation. During the early part of a crime scene investigator's career, the apprentice should concentrate on general studies. "Jack of all trades, master of none" should be the guiding philosophy. The basic skills you develop as a crime scene investigator will set the foundation for your success or failure in your chosen field.

This workbook contains exercises that will reinforce the material presented in the accompanying handbook (*Complete Crime Scene Investigation Handbook*). The goal is to help the reader develop the skills needed to build a solid foundation for a career as a crime scene investigator. Most crime scene investigators understand that it is practically impossible to be an expert in every aspect of crime scene investigation. If you work in an agency where crime scene investigators are not specialized, you may reach a point in your career where a specific area attracts your attention, and you desire to gain more training and experience in that particular area. However, if you begin to specialize too soon, you run the risk of narrowing your scope before becoming a well-rounded crime scene investigator. This workbook is designed to help build that foundation, and the exercises are designed to reinforce the lectures presented in the handbook. The exercises encompass all aspects of the basic course for a crime scene investigator.

As a crime scene investigator, your reports should be more descriptive than those at the level of the patrol officer. After most of the exercises presented in this workbook, there is space provided for you to write descriptions of what you observed. Some of the exercises require you to write a comparative description of different parts of the exercises. This part of the workbook was included to stimulate readers of the *Complete Crime Scene Investigation Handbook* to write more descriptively.

I believe in a simple learning process: Teach the students in a formal lecture setting, demonstrate the techniques, and then allow the participants to perform the tasks on their own. This handbook and workbook were created with this concept in mind. The curriculum has been divided into six sections. Within each section are several chapters that discuss the main topics of that particular section.

This workbook contains numerous exercises that are designed to reinforce the discussions in the *Complete Crime Scene Investigation Handbook*. This workbook has step-by-step photographs of many of the processes discussed in the accompanying handbook. I am well aware that in a normal 40-hour or even 80-hour crime scene investigations course, there is just not enough time to complete all the exercises. The instructors of the individual course should carefully select the most appropriate exercises.

Do not take the *Complete Crime Scene Investigation Handbook* or this workbook as the "be all/end all" guide to crime scene processing techniques. There are numerous variations to most of the techniques presented here. It is simply impossible to list all of the possible processing techniques in a single book. However, by understanding these techniques, you will gain a better understanding of the small and infinite variations that are possible.

The handbook and this accompanying workbook were written with several goals in mind. Firstly, they were written to provide the reader with a valuable resource on how to document evidence. Secondly, they were written in an effort to increase the quality of crime scene and evidence documentation. Finally, both books were written in the hope of stimulating others to continue their forensic education in specialized areas from specialized instructors.

A supervisor of mine (Lt. Craig Gravel) eloquently put the forensic learning process into three categories:

1. Those who have been trained in the discipline
2. Those who know the discipline
3. Those who understand the discipline

Everyone entering the field of crime scene investigation receives some form of training. This training may range from self-taught to the taking of formal courses. Without any further effort on your part, your *training* has already placed you in the first category—those who have been trained. With continued training and studying, you will be able to move into the second category, that of *knowing* the discipline. If you are unsure of where you stand, teach a class. As the instructor, you will quickly discover that even though you may know the discipline very well, you are far from *understanding* the discipline.

If it is so hard to rise to the level of understanding, how did experts like Tom Bevel, Stuart James, William Bodziak, Michael Haag, and numerous others rise to that level of understanding? Achieving the level of understanding within your discipline is possible only through many years of formal training courses, individual study and research, and ultimately teaching courses within the discipline.

I strongly believe that when you quit learning in a discipline, it's time to move on to another area. I believe that

no matter how many times you attend the same training courses, you should have the same basic goal, and that is to learn something new. I also believe that this should apply to instructors as well. If your goal as an instructor is to also learn something about the discipline from your students, you are well on your way to understanding the discipline.

The goal I established for myself when I began writing the *Complete Crime Scene Investigation Handbook* and this accompanying workbook was, first and foremost, to provide a valuable resource to crime scene investigators. My second goal was to provide a resource to smaller agencies that may lack the funding to send their investigators to an official training class. There are approximately 21,500 law enforcement agencies in the United States and nearly 80% of them are 20-member departments or smaller. I hope that these small departments will benefit from this work. The final goal of this work is to stimulate investigators to continue their forensic training and education by taking classes in specific subject matters, such as bloodstain pattern analysis, shooting scene reconstruction, crime scene photography, footwear and tire impressions, questioned documents, etc. It is my sincere hope that any information you may gain from this text will help you get the most out of any future forensic training you undertake.

Everett Baxter Jr.

Acknowledgments

As with the handbook that this workbook accompanies, I would like to thank all the people who have helped me with these volumes: Scott Rowland, Jerry Bowman, Craig Gravel, Steve Deutsch, The Norman Police Department EMS Division, the FARDO-Cad Zone, Jerry Kramper with Forensic Source, Spex Forensics, Elaine Taylor, Yvonna Hill, Ron Wortham, and Patrick McLaughlin.

Lastly, I would like to thank my lovely wife Barbara. I know writing this book has not been easy. Thank you for the support and love you have shown me during this time. You are a very special person and I love you dearly.

About the Author

Everett Baxter, Jr. has more than 21 years of combined law enforcement experience. His education includes an associate's degree in applied science (emergency medical technology) from Oklahoma City Community College. As a licensed paramedic in the state of Oklahoma, he also received extensive training in medical emergencies, including instruction in how to identify the mechanism of injury on a human body. As a field paramedic, he gained invaluable experience in determining the mechanism of injury from auto collisions, shootings, stabbings, assaults, etc. He also has a bachelor of science degree in chemistry from the University of Oklahoma.

Once a member of the Oklahoma City Police Department's crime scene unit, Baxter was able to put his medical and scientific education to use as an investigator. He continued his training with numerous courses in bloodstain pattern analysis, shooting scene reconstruction, fingerprinting, and forensic mapping. He currently teaches a basic crime scene investigations course for the Oklahoma City Police Department. He is also an adjunct professor for a local college, where he teaches Technical Investigations (the college's name for the Crime Scene Investigations course), Police Photography, and Basic Bloodstain Pattern Analysis.

Course Format

ISO/IEC

This course is based on the standards set forth by American Society of Crime Laboratory Directors (ASCLAD) and Forensic Quality Services (FQS). These organizations utilize ISO/IEC standards to accredit laboratories that perform analyses on evidence from criminal cases. These standards establish how laboratories may receive evidence for analysis. The procedures established in this course meet and, in most instances, exceed these standards.

SWG

Many of the forensic science disciplines also have an established scientific working group (SWG). Many of these groups are funded by the FBI. These groups were established to develop standards within the specific forensic science disciplines. These standards include terminology and standard procedures for documentation and collection of the specific evidence as well as standard procedures used to analyze the evidence. This course utilizes these standard terminology, documentation, and collection procedures.

Student Input

The instructor recognizes that investigators participating in this course come from a wide variety of training and experience. Comments and questions throughout the course are welcomed and encouraged. Please, however, refrain from discussing or teaching older techniques that you may have been taught or used. The techniques presented here are expressed in a manner that the experts need in order to provide the highest quality analysis from the evidence. The techniques you were taught may or may not conform to those SWG standards.

Section 1

Introduction

1 The Investigative Team

The processing of a crime scene is not a single investigator's effort but, rather, is brought together as a team effort. The team approach allows each of the members to utilize their area of expertise toward the common goal of solving the crime. This team approach also reduces the need for one person who has to "know" everything about the investigation and processing of a crime. Team members are able to rely on others' expertise in such areas as crime scene investigations.

THE INITIAL RESPONDING OFFICER

He or she is responsible for bringing a chaotic, uncontrolled scene under control. Their actions play a very critical role in the overall investigation. The officer's actions should be based on priority:

1. *Officer safety*
2. Medical attention
3. Securing witnesses, etc.

Securing a crime scene is done in stages. First, determine what the actual scene encompasses; next, clear the scene from all unnecessary people, witnesses/suspects, and bystander officers; and, finally, set boundaries in place.

Make mental notes as the scene is being cleared:

1. Odors
2. Which lights were on, which were off
3. Which doors were opened, closed, locked, etc.

Consider the suspect's actions as you clear the scene to avoid unnecessarily disturbing evidence. Once the scene has been cleared, secure the scene with physical boundaries. All scenes need to be secure. Officers should make the crime scene as large as possible. Remember that it can always be made smaller. Once the media arrive, it will be difficult to enlarge.

Natural Boundary

Natural boundaries include a row of hedges that have no opening to the crime scene, a stockade fence, the side of a building, etc. These natural boundaries, along with some crime scene tape, can make a good barrier.

Artificial Boundary

Artificial boundaries include crime scene tape, marked police vehicles, and uniformed officers. No matter what boundary or combination of boundaries you choose to use, an officer must be stationed nearby to ensure that no one crosses the established boundary. Officers must remain at the scene to help control the media, family members, and onlookers and keep unwanted individuals from entering the scene.

Start a Crime Scene Log

The crime scene log (Figure 1.1) records all who have entered the scene. It should list

1. The person's name
2. When the person entered the scene
3. When the person left the scene
4. The purpose for entering the scene

A properly secured crime scene establishes and maintains the overall integrity of the scene. The more people walking through the scene, the greater is the risk of loss of fragile trace evidence.

THE CRIME SCENE INVESTIGATOR

His or her job is to:

1. *Document the scene*: This is done through photography, note-taking/reports, and sketches.
2. *Identify the evidence*: This is probably the most important duty of all. Failing to identify evidence means that that particular evidence will not be collected. The *first* priority is to process the scene and *not* reconstruct the scene.
3. *Properly process and collect the evidence*: Some evidence must be processed at the scene prior to being collected, for example, collecting hairs on a beer bottle, collecting DNA swabs, etc. Other evidence may be collected and then processed in the lab.
4. *Properly process and submit the evidence*: Even though evidence may have been processed at the scene, additional processing may be necessary in the lab, e.g., analyzing photographs, swabs, fingerprints, etc.
5. *Prepare written reports and additional supporting materials*: The job is never done until the paperwork is complete: scene report, supplemental reports, and sketches.

Crime Scene Entry/Exit Log

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident	Date Log Initiated	Date Log Completed
Officer Initiated Log:	Officers Maintaining Log:			

Name & Comm./Badge/ID No.	Unit No.	Arrived		Departed	Duties At Scene	Scene Entered	
			/			☐ Yes	☐ No
			/			☐ Yes	☐ No
			/			☐ Yes	☐ No
			/			☐ Yes	☐ No
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FIGURE 1.1 The crime scene log is one documentation method used to protect the integrity of a crime scene. This log should be completed for every crime scene.

Goals of the Crime Scene Investigator

The goals include:

1. *Do not rush the investigation*: Evidence being destroyed by the weather must be quickly identified and collected. Outside of that, time is on your side. Being methodical includes taking your time to ensure that the scene is properly processed.
2. *Eliminate mistakes/minimize omissions*: We are human and we are imperfect. Every scene processed will have omissions and mistakes. Omissions have minimal effects on the case, such as not taking another photograph to further document bloodstains. Mistakes have a much larger impact on the case, such as failing to collect a bloody knife underneath the bed.
3. *Remain neutral*: As crime scene investigators:
   - We don't work for the victim.
   - We don't work for the suspect.
   - We don't work for the chief of police.
   - We don't work for the prosecution.
   - We don't work for the defense.
   - **We work for the truth**.

THE DETECTIVE

The detective is generally the overall manager of the case. Detectives are responsible for the overall investigation. They are responsible for conducting interviews. One should be present during the processing of the scene to relay information back and forth between interviewing detectives and the scene detectives.

THE ANALYST

The analyst is the individual who will perform some form of analysis on the evidence: DNA/serology, firearms examinations, drug analysis, paint analysis, trace analysis, etc.

THE PROSECUTOR

The prosecutor is the person who takes the case to trial.

THE DEFENSE ATTORNEY

The defense attorney's job is to ensure that the defendant's rights were not violated.

THE CRIME SCENE ANALYST/RECONSTRUCTIONIST

The crime scene analyst/reconstructionist is the individual hired to attempt to answer additional investigative questions.

EXERCISES

The exercises here are designed to reiterate this point and provide you with some additional understandings of the specific jobs required by each member of the investigative team. The exercise is to write the "job" description of each team member as it relates to a criminal investigation.

EXERCISE 1.1

The Initial Responding Officer:

EXERCISE 1.2

The Crime Scene Investigator:

EXERCISE 1.3

The Detective:

EXERCISE 1.4

The Analyst:

EXERCISE 1.5

The Prosecutor:

EXERCISE 1.6

The Defense Attorney:

EXERCISE 1.7

The Crime Scene Analyst/Reconstructionist:

2 Forensic Search and Seizure

DO WE HAVE THE RIGHT TO BE AT THE SCENE?

The answer depends on the circumstances of the crime and the actions of the suspect and victim, as well as their willingness to consent to search.

The Fourth Amendment

The Fourth Amendment does not prohibit searches and seizures. It does prohibit *unreasonable* searches and seizures:

1. Protects people and not places.
2. Makes the subjective intentions of officer/defendant largely irrelevant.
3. Emphasizes the reasonableness of search or seizure.
   - *Search*: A search is an action by the government that intrudes upon a person's reasonable expectation of privacy.
   - *Seizure*: There are two strands of seizure:
     1. Physical restraint
     2. Lawful show of authority

Physical Restraint

A person is not *seized* under the Fourth Amendment unless that person is physically restrained or submits to a lawful show of authority. In *California v. Hodari D.*, the subject was not seized while being chased by police, and thus the issue of whether there was reasonable suspicion justifying the police action was irrelevant.

Standing

The concept of *standing* derives from the "reasonable expectation of privacy" standard. The Fourth Amendment does not apply when evidence is offered against a defendant seized from someone else's place. *Katz v. United States* abolished any vestige of a prior "trespass doctrine": "the Fourth Amendment protects people and not places." There is a two-prong test:

1. Is there a *subjective expectation* of privacy?
2. If so, is that *expectation* one that society is willing to recognize as *reasonable*?

The courts have weighed in on the issue of standing:

- *U.S. v. Lewis* and *U.S. v. Erwin*: Passengers in the vehicle generally lack standing.
- *California v. Brendlin* and *U.S. v. Nava-Ramirez*: Passengers can challenge the lawfulness of the traffic stop.
- *Oklahoma v. Johnson*: Passenger can give consent if the officer knows that the passenger is the owner of vehicle.
- *U.S. v. Jefferson*: The nonowner of a vehicle has no standing when the owner of the vehicle is a passenger in the vehicle.
- *U.S. v. Arango*: Merely being in possession of a vehicle does not satisfy the test for standing. The driver must show evidence that he or she had the owner's permission to use the vehicle.
- *U.S. v. Shareed*: A driver not on the rental agreement or listed as an authorized driver has no standing.
- *U.S. v. Edwards*: The person does have standing to consent to a police search of the luggage in the trunk.
- *Minnesota v. Olsen*: Overnight houseguests have standing in common areas and areas where they exercise exclusive control. The general rule on hotels/motels is that standing ends at checkout, unless the hotel/motel has a policy of allowing patrons to stay past checkout time.
- *U.S. v. Rhiger*: Frequent social guest with frequent overnight stays has standing even if the owners aren't home when the individual has access to the residence and there are receipts in the home.
- *U.S. v. Thomas*: A person who is staying at a relative's house for several days to celebrate the holidays has standing.
- *Oklahoma v. Smith*: Standing is abandoned when the resident steps off the porch and into the front yard and throws down a baggie of cocaine.

Scope of Search

The concept of *scope of search* refers to the specific permission given to conduct the search. The scope of the search may not exceed the consent given.

- *Florida v. Jimeno, 500 U.S. 248 (1991)*: Consent to search the entire inside of the vehicle was also deemed consent to open paper bag on floorboard.
- *U.S. v. Osage, 235 F.3d 518 (10th Cir. 2000)*: Before an item can be rendered a useless container that would otherwise be within the scope of a permissible search, the officer must obtain explicit authorization or have some other lawful basis upon which to proceed.
- *U.S. v. Elliott, 107 F.3d 810, 815-15 (10th Cir. 1997)*: Trooper asks for consent to search trunk "Just wanted to see how things are packed." The driver granted consent, and the trooper moved and opened a duffel bag, which was beyond the scope.
- *U.S. v. Santurio, 29 F.3d 550, 553 (10th Cir. 1994)*: A failure to object to the continuation of a search indicates that the search was conducted within the scope of the consent given.

- *U.S. v. Wald, 216 F.3d 1222 (10th Cir. 2000)*: Applies only when initial consent is of a general nature and not of a limited nature. If consent was limited, then failure to object to officers expanding the scope does not act as consent to the broader search. However, removing a nailed-down plywood cover on the luggage area of an RV was permissible where officer had consent to search the RV for narcotics.

If *you* were not present when the consent was requested and subsequently granted, ask when consent was requested, what was asked for, and what was granted so that you *know* what the scope actually is.

LEGAL MEANS TO PROCESS SCENE

Consent

The state has the burden of proving that consent was freely and voluntarily given. *Consent* is the act of intentionally or knowingly relinquishing or abandoning a known right, claim, or privilege. A suspect may waive his or her Fourth Amendment rights and permit a search. The burden is upon the state to show that the defendant knowingly and intelligently waived his rights. The state also bears the burden of proving that the consent was voluntary and not the product of coercion. Document the following:

1. Who provided consent for the search?
2. What authority does the consenting person have over the property being searched?
3. What is the condition or state of mind of the consenting person?
4. Where will the person providing consent be during the search?

Whether or not the consent is given freely and voluntarily will be judged from the totality of the circumstances.

- *Schneckloth v. Bustamonte*: Any threat or promise, express or implied, however slight, which prompts a consent will render the search invalid. There is no constitutional requirement to inform the person of his or her right to refuse. A person may give valid consent even after being arrested. Consent can be revoked at any time. Do not allow the person or suspect to watch the search. Never allow persons or suspects back into the scene.
- *Foster v. Oklahoma*: Consent in exchange for a promise to free a relative from custody may render it invalid.
- *Dale v. Oklahoma*: Consent was not voluntary when eight armed officers climbed a locked gate and approached a suspect at his residence. Agents were dressed in military fatigues, and a helicopter was hovering overhead.
- *S.L.R. v. State:* Status as a juvenile, per se, is no bar to the ability to give free and voluntary consent. This assumes, of course, that the juvenile has some joint access to the area in question.
- Cohabitants have a shared access or control, which generally gives each party legal authority to consent to a search.
- *Georgia v. Randolph* (March 22, 2006): However, one party's consent no longer permits a search when another party is present and objects. This does not explicitly overrule the 1974 decision *U.S. v. Matlock*, but cuts an extremely close line.
- *U.S. v. Rodriguez-Garcia*: A person can still give valid consent to search even after invoking *Miranda* rights.
- *Oklahoma v. Huddleston*: Persons cannot provide consent in Oklahoma after invoking their *Miranda* rights.

Doctrine of Apparent Authority

- *Reeves v. Oklahoma*: Search will be upheld if the consenting party turns out to have no authority. The test is one of objective reasonableness as to the officer's belief that the person could consent.

Conduct as Consent to Search

This is possible, but it must be sufficiently clear that a reasonable person would intend that conduct to mean "yes" in response to an officer's request. Mere silence may never constitute consent. Silence during a search may indicate that the officer's actions are still within the scope of the consent. Was the consent general versus a specific request?

- *Oklahoma v. Kudron*: A hand gesture with other evidence may be sufficient to show consent.
- *Lumpkin v. Oklahoma*: Consent was granted when officers asked to look in the trunk and defendant said nothing but went and got keys from the ignition.
- *U.S. v. Gordon*: Consent was given when defendant handed the officers a key to a duffle bag when officers asked, "Can you open that?"

Verbal Consent

Victim gives verbal permission to process/search a home or vehicle for evidence. This is more accurate when dealing with stolen vehicles, burglary scenes, robbery scene, etc. If you receive permission to search a premise for a TV and you find a gun in a drawer, is the gun admissible? No. Why? A TV will not fit in a drawer, so you have no reason to look there, the exception being a small handheld TV.

Search Waiver

Written consent to search premises or vehicle.

Search Incident to Arrest

- *Chimel v California*: It is reasonable for an officer to search an arrestee for weapons and evidence. Search is limited to the area under "immediate control." Courts defined this as lunging distance.
- *Gant v Arizona*: Search incident to arrest is no longer justified once the occupant has been removed from the vehicle/area *unless* you have "reason to believe" there is evidence for the crime for which the occupant was arrested, such as a DUI. The officers can search for beer/alcohol bottles. It does not invalidate the *Carroll* search. Probable cause and the apparent mobility of the vehicle are all that is necessary for a warrantless search.

Exigent Circumstances

A warrantless search may be found to be reasonable in the face of exigent circumstances, i.e., danger to human life or imminent destruction of evidence. It also applies to collection of forensic evidence as well as other areas of search-and-seizure law. The factors include

1. Clear evidence of probable cause
2. The seriousness of the offense and likelihood of destruction of evidence
3. Limitation of the search to minimize the intrusion only to preventing destruction of evidence
4. A clear indication of exigency per *U.S. v. Reed*, 953 F.2d 641 (4th Cir.), cert. denied, 502 U.S. 960 (1991). The exigency may also be determined by
   1. The degree of urgency involved
   2. The amount of time needed to get a warrant
   3. Whether evidence is about to be removed or destroyed
   4. The danger at the site
   5. Any knowledge of the suspect that police are on his or her trail
   6. Ready destructibility of the evidence
      - *Lee v. State*: Impending rain constituted exigency justifying collection of bloodstains on the outside of a car.
      - *Harjo v. State*: Seizure of a murder suspect's tennis shoe after officer viewed tread, which appeared to match tracks at the murder scene.
      - *Michigan v. Tyler* (upheld) and *Michigan v. Clifford* (evidence suppressed): Warrantless entry and seizure of evidence from fire scenes.

Search Warrant

A search warrant is a commission or document giving authority to do something, e.g., a writ issued by a judicial official authorizing an officer to perform a specified act required for the administration of justice. It is an order from a court to perform a specific task. When we have probable cause that a search warrant is needed, we fill out a written request for the search warrant. The warrant should include:

1. Probable cause
2. Facts to show probable cause
3. Description of the premises to be searched—dwelling, vehicle, building, etc.
4. Addresses; physical descriptions of the dwelling or vehicle
5. What we are looking for (evidence)

Prepare an affidavit for the search warrant. This is for the judge to understand who is requesting the warrant (describe credentials), what occurred at the scene, and what items of evidence are sought. Only the items described in the search warrant may be seized.

Search Warrant Returns

The return document is filed within 10 days of the warrant being issued. Returns are actually a convenience to the serving of a search warrant. By Oklahoma statute, you are to physically bring *all* items seized to the judge for inspection. The return will show the judge what items of evidence were seized. The return is also signed by a judge. The warrant and the return are filed with the court clerk's office.

Court Order

This is a document from a court ordering someone to do something specific such as providing bodily samples (e.g., hair, saliva, etc.), paying restitution, giving teeth impressions, etc.

Exceptions to the Warrant Requirements

The Plain-View Doctrine

- *Harjo v. State:* Asking a murder suspect to show the bottom of his tennis shoes during questioning is permissible if the soles were in plain view. Any movement or manipulation required to ascertain whether an item is evidence/contraband constitutes a search.

Application to Computer Searches

- *U.S. v. Carey:* 10th Circuit finds that multiple jpg files were not in plain view during a search for *text files* on a computer.
- *U.S. v. Walser:* 10th Circuit upholds a second search warrant based on opening one or two jpg files during a search for *documents* on a computer.

Enhancements to Ordinary Human Senses

Thermal imaging is a search when used to detect information inside a residence. A flashlight is considered to be an

extension of the ordinary human senses and does not convert plain view into a search. Binoculars, telescopes, and even nightscopes generally do not constitute a search. Courts look at how commonly used the technology is.

Open Fields

Pastures, open waters, woods, and other areas are not covered by the warrant/consent search requirements.

Distinguishing open fields from curtilage:

Curtilage: Harbors the intimate activity associated with the sanctity of a person's home and privacies of life.

Open fields: Are essentially all other areas.

Emergency Doctrine

In an exigent circumstance, probable cause must exist.

- *U.S. v. Smith, 797 F.2d 836 (10th Cir. 1986)*: In the emergency doctrine requiring a reasonable basis, the approaching probable cause of an emergency requiring immediate action by the officer qualifies as a reasonable basis. Five factors for determining the reasonableness of an emergency search are as follows:
    1. Basis for believing an emergency exists
    2. Gravity of the situation
    3. Extent of the intrusion that the search will cause
    4. Availability of less-intrusive alternatives
    5. Chances that the intrusion will prove successful
- *Oklahoma v. Foster, 741 P.2d 1031 (Okla. Crim. App. 1986)*: Generally, an emergency exists whenever officers have credible information that an unnatural death has or may have occurred. Emergencies are examined under the "primary motive" test.
- *New Mexico v. Ryon (2005)*: "It is unreasonable for officers to completely abandon their investigative function…but, the protection of human life must be the primary motivation to enter the home, not the desire to apprehend a suspect or gather evidence."

Abandoned Property

There are no Fourth Amendment protections for abandoned property. Narcotics agents may sift through the trash of the target.

- *U.S. v. Long, 176 F.3d 1304 (10th Cir. 1999)*: Trash bags on a trailer with camper shell parked between alley and garage—7 ft from garage and 3 ft from alley—were not curtilage, and trash was seized lawfully.

Exclusionary Rule

Evidence obtained through an illegal search is generally not admissible by the prosecution during the defendant's criminal trial.

Fruit of the Poison Tree Doctrine

Any subsequent information from illegally seized evidence may also be inadmissible in court.

Exceptions to the Exclusionary Rule

- *U.S. v. Calandra, 414 U.S. 338 (1974)*: Grand juries can use illegally obtained evidence in questioning witnesses because to hold otherwise would interfere with grand jury independence, and the place to contest the illegal search is *after* the accused is charged.

"Good Faith" Rule

- *United States v. Leon, 468 U.S. 897 (1984)*: Officers relying on "good faith" that evidence collected under a warrant that was later determined to be defective was still admissible. The U.S. Supreme Court has held that the rule does not apply in certain situations:
    1. Probation and parole revocation hearings
    2. Tax hearings
    3. Deportation hearings
    4. When government officials illegally seize evidence outside the United States
    5. When a private-sector entity (i.e., not a governmental employee) illegally seized the evidence
    6. When the illegally seized evidence is used to impeach the defendant's testimony

Forensic Evidence

Carroll Searches

Carroll doctrine allows search and seizure of an apparently mobile vehicle based upon probable cause sans warrant. Recent cases have held that the doctrine even applies when

1. The vehicle is temporarily immobilized.
2. The vehicle is removed to another location for the actual search.
3. The search is delayed by hours or days.

- *Michigan v. Thomas*: "When police officers have probable cause to believe there is contraband inside an automobile that has been stopped on the road, the officers may conduct a warrantless search of the vehicle, even after it has been impounded and is in police custody."
- *Selsor v. State*: Requires warrant to search vehicle in police impound custody.

Blood, DNA, Body Samples

General rule: Probable cause is required for any intrusion below the skin. Blood/breath tests of public employees is a search under the Fourth Amendment.

Incident to Arrest

Courts generally uphold minimally intrusive examinations of a person's body upon arrest.

- *Faulkner v. State*: Extracting strands of hair from head. Pubic hair/private searches: majority of cases where these searches have been upheld have been with probable cause. This turns not only on probable cause, but balancing the intrusion into personal dignity.
- *Cole v. Parr*: Generally, before blood and tissue samples may be ordered by a court, the state must show at an evidentiary hearing the relevance by testing samples from a victim or at a crime scene.
- *Mollett v. State, 1987 Okla. CR 28, 939 P.2d 1*: However, where the relevance was established through an affidavit for a search warrant, the hearing was not required.
- *Elix v. State*: Also, when probable cause has been established at a preliminary hearing, the court may order production of hair, saliva, and blood samples. Evidence obtained by surgery or other intrusions beneath the skin: Probable cause and exigent circumstances permit taking of blood from a drunk driving suspect. This turns largely on the reasonableness of the procedure as performed by medical personnel.
- *Winston v. Lee*: When surgery is required, even probable cause may not be enough. This case did not establish a bright line against ever compelling surgery, but set forth balancing factors.

The exercises in this chapter are scenario based and designed for you to provide a response to the given scenario. Your response should identify who actually has standing and who can object to the search. Your response should also describe *all* the possible legal means necessary to process this particular crime scene.

EXERCISES

EXERCISE 2.1

A 15-year-old girl is home sick from school. An individual kicks in the back door and begins to burglarize the residence. He is taking property from the kitchen and living room when he discovers someone is in the residence. He immediately flees the residence. The parents are at work and unable to be reached.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.2

A male rents a hotel room where he commits a rape. The victim leaves the hotel at approximately 1000 hours the following morning, when she notifies the police of the incident. Checkout time for the hotel is 1100 hours.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.3

A male and female are involved in a domestic assault where the female has visible injuries and informs officers that she was also hit with a baseball bat. Both the male and female reside at the residence. The female is at the hospital when the police are notified.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.4

The scenario is the same as described in Exercise 2.3, except the female gives consent to search. Once the officers arrive, the male refuses to allow officers to process the scene.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.5

A family friend is house-sitting at a residence while the residents are out of town on vacation. During this time, the house is burglarized.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.6

A vehicle is taken during a residential burglary. The police locate the vehicle while it is occupied and initiate a pursuit of the vehicle when the driver attempts to flee. The vehicle is eventually located unoccupied.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.7

A vehicle is used during a residential burglary. The vehicle is observed leaving the scene as officers arrive. Police initiate a pursuit of the vehicle when the driver attempts to flee. The vehicle is eventually located unoccupied. Through investigative efforts, it is learned that the vehicle is owned by the possible burglary suspect.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.8

A vehicle is taken during a residential burglary. The police locate the vehicle while it is occupied and initiate a pursuit of the vehicle when the driver attempts to flee. The vehicle is eventually located unoccupied. Through investigative efforts, it is learned that the owner loaned the vehicle to an individual matching the description of the suspect.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.9

A male and female are at a residence having a dispute. The female (an adult) is the daughter of the woman (who is not home at the time of the incident) living with the male. During the argument, the male produces a firearm. The male and female then fight over the firearm, and it discharges during the struggle, striking the male. The male is transported to the hospital.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.10

The scenario is the same as that described in Exercise 2.9. However, in this case, the adult female currently resides in another state.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.11

An adult male resides in a residence with his elderly mother. The mother actually owns the residence, and the son lives in one of the bedrooms. The male brings a female over to the residence, where she is subsequently raped in the male's bedroom.

Who Has Standing:		
Who Can Object to the Search:		

EXERCISE 2.12

The scenario is the same as that described in Exercise 2.11. However, when the male is asked for consent to search, he makes the following statement: "I really don't want to consent to the search, because if I do, you will find evidence of the incident; and if I don't, you will just go get a search warrant."

Who Has Standing:		
Who Can Object to the Search:		

Section II

Documentation

3 Note-Taking Exercises

PURPOSE OF DOCUMENTATION

The purpose of documentation is to permanently record the condition of the scene and its physical evidence. It records what the investigator observed; it records what the investigator did; and it is useful in debriefings, both informal and formal. The three primary documentation methods include

1. Note taking (Chapter 3)
2. Photography (Chapter 4)
3. Sketches (Chapter 5)

NOTE TAKING

Note taking—the initial aspect of crime scene documentation—is used as a guide for writing the final report. It is a court preparation tool; it allows for outside analysis; and it may also be a useful training tool.

TASK LISTS/TO-DO LISTS

To-do lists are used when you cannot process something a detective or investigator needs to document at that very moment or there is some item you must return to at a later date. When a request that can be put off is made, make a note of what was requested and who made the request. For urgent requests, make a note of your current task and where you left off.

FIELD NOTES

Taking field notes is one of the most important duties of a crime scene investigator. These notes are used to commit observations to writing, enabling crime scene investigators to keep a detailed record of what they did. Field notes should be

1. Written in chronological order
2. Detailed in a step-by-step format
3. Complete and thorough
4. Clearly written
5. Include negative processing methods as well as positive, i.e., no prints found on the drink can or prints were found on the door window
6. As specific as possible
7. Kept in the case jacket or case folder according to department policies and procedures

Using a notepad, write the main ideas along the center section, using the margins for:

1. Dates and times
2. General info such as labels (gun, living room, etc.)

Note Categories

Note categories include:

The initial notification: Note
1. How you got the call
2. Date and time crime reported to police
3. Date actual crime took place
4. Type of crime
5. The extent of the scene
6. Actual location of the crime
7. Location of the crime scene to be processed

Arrival at scene: Document
1. Time of arrival
2. Name of officer maintaining crime scene log
3. Your approach to the scene
4. How the scene was secured

Scene briefing: Note
1. Weather and lighting conditions
2. Who provided the initial briefing
3. Brief summary of what occurred
4. Name of the person requesting the investigation
5. Names of everyone at the scene, including witnesses
6. Names of people who will do the crime scene search
7. Identify legal right to process scene.

Scene description: This documentation should include
1. Description of the exterior of the scene
2. Description of the interior of the scene
3. Room layout
4. Location of doors and windows
5. Location of the furniture
6. Description of the surrounding location
7. Description of the primary scene, i.e., the body (*Do not* include evidence and other investigative actions here; they will be included in the next section.)

Scene investigation: This documentation should include
1. Location of the evidence
2. Notation of who initially located the evidence
3. Description of the evidence
4. Description of any peculiar odors and sounds
5. Notation of any observations made by patrol
6. Description of the possible suspect
7. Description of suspect actions, e.g., how the suspect got to the scene
8. Description of what the suspect did in the scene
9. Description of how the suspect left the scene

10. Description of footwear/tire impressions
11. Notation of date and time when scene investigation was completed

Scene processing and collecting methods: Document
1. The methods used to process the evidence at the scene
2. The results obtained, both positive and negative
3. Who collected the evidence
4. How the evidence was collected
5. How the evidence was packaged

Lab processing and collection methods: Describe
1. The methods used to process the evidence prior to actually submitting the evidence for storage (This includes any presumptive tests, photographs, swabs, chemical enhancements, etc.)
2. The results obtained, both positive and negative

Evidence packaging and submission: Document
1. How the evidence was packaged for final submission
2. Whether a new package or original packaging was used, keeping in mind that using original is best (The original may not be usable if it becomes blood soaked. If a new bag was used, what was done with original bag? If it contains trace evidence, it should be included inside the new bag.)
3. Where was the evidence submitted?

Office activities: Document
1. All sketches
2. Case jacket or case file
3. Other activities related to the case

Figure 3.1 is an example of a field notes and documentation form.

Vehicle documentation: Documenting a vehicle begins with exterior documentation, which includes
1. Vehicle condition
2. Damage
3. Tag
4. Vehicle identification number (VIN)
5. Tag registration decal
6. Safety inspection sticker (if applicable)
7. Any evidence located
8. Any processing techniques, to include positive and negative results

The interior documentation is similar to the exterior documentation
1. Interior condition
2. Damage
3. Evidence
4. Any processing methods, to include positive and negative results.

Vehicles require extensive documentation, not necessarily the detailed descriptions but rather in the areas actually processed. This is especially true when you have to document the locations where swabs were collected and/or areas processed for latent fingerprints.

Figure 3.2 is an example of a vehicle-processing form.

EXERCISES

The purpose of this set of exercises is to improve the student's detailed descriptions and documentation of a crime scene or evidence that is often required of crime scene investigators. Notes are also necessary to assist in the completion of the final report. Oftentimes, the report contains additional information such as the time the call was received, when you arrived at the scene, when you left, and other clerical-type information. When using descriptions, you should avoid using slang terms. Use the correct terminology for the item. For example, the metal support post for the driver and passenger edges of the windshield is called the *A pillar*. If you are unsure of the correct terminology, please do an Internet search on terminology or consult one of the SWGs (scientific working groups) for accepted terminology.

During these exercises, you will be shown a series of photographs. You will be given two minutes for each photograph. In the given spaces, write a detailed description of each of the photographs using the criteria from this chapter.

Field Notes

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident	Date of Crime:	Date Processed:

Location Processed:	Date/Time of request:	Arrival Time:	Departure Time:	☐ Warrant	☐ Waiver	☐ None

Detectives	Detective Supervisor:

Primary CSI:	Scene Photographer	Scene Sketcher	CSI Supervisor:

Primary Officer's Unit No.:	Officer's Name & Comm./Badge/ID No.:	First Unit on Call:	Officers' Name & Comm./Badge/ID No.:	Officer Initiating Crime Scene Log & Comm./Badge/ID No.:

Other Officer's & Comm./Badge/ID No.:	Patrol Supervisor & Comm./Badge/ID No.:

Scene Security/How Was Scene Protected:	M.E. Notified:	☐ N/A	☐ Yes	☐ No	Field Agent's Name

☐ SU	☐ VI		Race/Sex:	D.O.B. (mm/dd/yy):	☐ SU	☐ VI		Race/Sex:	D.O.B. (mm/dd/yy):
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:

Photos:	☐ Yes	☐ No	No. Images:	Sketch:	☐ **Yes**	☐ No	Evidence Log Book	☐ Yes	☐ No	Case Jacket:	☐ Yes	☐ No
Fingerprinting:	☐ Yes	☐ No	No. Cards:	Fingerprinting Method(s):								

Briefed By:	Brief Summary of What Occurred:

Weather Conditions:	Date Taken:	Time Taken:	Temperature:	Dew Point:	Pressure	Winds:	Relative Humidity:	Visibility:

Structure:	Point of Entry:	Point of Exist:
Lightning Conditions:	Description of Surrounding Houses/Streets:	

Scene Description/Additional Information:

FIGURE 3.1 Field notes and documentation form.

Vehicle Processing

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident	Date of Crime:	Date Processed:

Location Processed:	Date/Time of request:	Arrival Time:	Departure Time:	☐ Warrant	☐ Waiver	☐ None

Detectives	Detectives Present:	☐ Yes	☐ No	Vehicle	☐ Suspect	☐ Victim	☐ Stolen	☐ Other

Type of Processing Requested:

☐ SU	☐ VI		Race/Sex:	D.O.B. (mm/dd/yy):	☐ SU	☐ VI		Race/Sex:	D.O.B. (mm/dd/yy):
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:
☐ SU	☐ VI		Race/Sex:	D.O.B.:	☐ SU	☐ VI		Race/Sex:	D.O.B.:

Owner/Victim Smoker:	☐ Yes	☐ No	☐ Unknown	Vehicle Condition:	☐ Clean/Well Kept	☐ Slightly Messy	☐ Messy	☐ Other

Year:	Make:	Model:	No. Doors:	Color:	Tag:	Tag Mo./Yr.:	State:

Decal No.:	VIN:	Sealed	☐ Yes	☐ No	Date Sealed:	Initialed:	☐ Yes	☐ No	Initals:

Photos:	☐ Yes	☐ No	No. Images:	Sketch:	☐ Yes	☐ No	Evidence Log Book:	☐ Yes	☐ No	Case Jacket:	☐ Yes	☐ No

Fingerprinting:	☐ Yes	☐ No	No. Cards:	Fingerprinting Method(s):

Areas Processed For Fingerprints:

Driver Front Door:		☐ None	☐ Exterior Door	☐ Exterior Window	☐ Exterior Mirror	☐ Interior Door	☐ Interior Window	☐
Driver Rear Door:	☐ N/A	☐ None	☐ Exterior Door	☐ Exterior Window		☐ Interior Door	☐ Interior Window	☐
Driver Side:		☐ None	☐ "A" Pillar	☐ "B" Pillar	☐ Windshield	☐ Roof	☐ Sun-Visor	☐
Pass. Front Door:		☐ None	☐ Exterior Door	☐ Exterior Window	☐ Exterior Mirror	☐ Interior Door	☐ Interior Window	☐
Pass. Rear Door:	☐ N/A	☐ None	☐ Exterior Door	☐ Exterior Window		☐ Interior Door	☐ Interior Window	☐
Pass. Side:		☐ None	☐ "A" Pillar	☐ "B" Pillar	☐ Windshield	☐ Roof	☐ Sun-Visor	☐
Other Areas:		☐ Dash	☐ Dome Light	☐ Rearview Mirror	☐ Windshield-All	☐ Roof-All	☐ Hood-All	☐
☐ Area to Rear Driver Rear Door			☐ Area to Rear Passenger Rear Door		☐ Trunk-All		☐	
☐			☐		☐		☐	
☐			☐		☐		☐	

Areas Processed For Contact DNA:

Driver Front Door:		☐ None	☐ Ext. Handle	☐ Int. Handle	☐ Int. Pull Handle, Arm Rest and Top Edge of Door Panel			☐
Driver Rear Door:	☐ N/A	☐ None	☐ Ext. Handle	☐ Int. Handle	☐ Int. Pull Handle, Arm Rest and Top Edge of Door Panel			☐
Pass. Front Door:		☐ None	☐ Ext. Handle	☐ Int. Handle	☐ Int. Pull Handle, Arm Rest and Top Edge of Door Panel			☐
Pass. Rear Door:	☐ N/A	☐ None	☐ Ext. Handle	☐ Int. Handle	☐ Int. Pull Handle, Arm Rest and Top Edge of Door Panel			☐
Other Areas:		☐ None	☐ Steering Wheel	☐ Gearshift Lever	☐ Rearview Mirror	☐ Dome Light	☐ Glove Box Lever	☐
☐			☐		☐		☐	
☐			☐		☐		☐	

Notes/Additional Information:

FIGURE 3.2 Vehicle processing form.

EXERCISE 3.1

Description of Photograph #1

EXERCISE 3.2

Description of Photograph #2

EXERCISE 3.3

Description of Photograph #3

EXERCISE DISCUSSION

You are not going to write a description for every photograph you take at the scene. Your notes should include a description of each area that was photographed. For example, you take 15 photographs documenting the overall condition of a room. You should write a brief description of the room. This description should be supported by the photographs. The other point of this exercise is that it shows that it is easier to take photographs than to write detailed information for each photograph. As the crime scene investigator or evidence technician, you should avoid using the photographs as your field notes.

4 Photography Exercises

USES OF PHOTOGRAPHY

Documentation of the crime scene—consisting of note taking, photography, and sketching—is truly the most critical element of scene processing. No one element can replace the other. Note taking is an important element that has to be done accurately and thoroughly. The photography process should be slow and methodical. Photographs may be used for

1. Documentation of a crime scene
2. Documentation of vehicle collisions
3. Training
4. Prevention of crime and fires
5. Public relations
6. Identification purposes
7. Detection of offenders
8. Identification of victim/suspect, etc.

PHOTOGRAPHIC TERMS

The *film plane* is the plane where the image will be focused upon, either the film or image sensor. The *focal point* is the point where light is focused when it enters the camera. The *focal length* is the distance in millimeters (mm) between the optical center of the lens and the film plane when the camera is focused at infinity. The *field of view* is the entire viewable area. This includes both areas in and out of focus. Humans have an almost 180° field of view. The *angle of view* is the area of the field of view that is in focus.

Angle of view: The angle of view (AoV) is the area of the field of view that is in focus or is focused on the image sensor or film. The angle of view is directly related to the focal length. The shorter the focal length of the camera, the greater the field of view will be, and vice versa. The angle of view may be measured horizontally, vertically, or diagonally. Figure 4.1 illustrates the three different angles of view. Thus, using the diagonal measurement, a 50 mm lens has an AoV of 44.8° on a 35 mm film sensor (the 35 mm film dimensions are 24 mm [vertical] × 36 mm [horizontal], giving a diagonal of about 43.3 mm), but an AoV of 31.7° on an Advanced Photo System type-C (APS-C) is in image-sensor format (14.7 mm [vertical] × 24.1 mm [horizontal], giving a diagonal of about 30.1 mm). For a four-thirds (4/3) image sensor size, the AoV is 24.4° (from Olympus and Kodak), and the size of the sensor is 13.5 mm (vertical) × 18 mm (horizontal), giving a diagonal of about 22.5 mm. And a 300 mm lens has an AoV of 8.3° on a 35 mm film sensor, but an AoV of 4.7° on an APS-C CCD (charge-coupled device) sensor. Figure 4.2 illustrates the various angles of view as they relate to the various focal lengths. There are two numbers associated with each focal length. The first is the actual focal length and the second is the actual angle of view. For example, take the 15 mm wide-angle lens, which has an angle of view of 111°, while the normal lens of 50 mm has an angle of view of 44.8°, and the 1200 mm telephoto lens has an angle of view of 2.1°.

Angle of view (AoV) for macro photography: When using extreme close-up (macro) focus distances, the magnification (reproduction ratio) needs to be taken into account. This is factored by multiplying the focal length by 1 plus the reproduction ratio. For macro photography, the effect of reproduction ratio on the AoV needs to be considered.

Camera lens: The *normal lens* is the depth perception similar to the naked eye. The *wide-angle lens* is any focal length shorter than the normal lens. The *telephoto lens* is any focal length longer than the normal lens. The *macro lens* is a specially designed lens for close-up photography. The lens is flatter across the entire lens than the other lenses. The *zoom lens* is a lens that is capable of changing its focal lengths. Lenses on point-and-shoot cameras are permanently mounted lenses. They have limited aperture ranges, generally f/2.8 to f/4.4. Values above f/4.6 cause large amounts of diffraction.

Maximum and minimum apertures: Lenses define the maximum and minimum aperture based on the focal length.

Auto-focus lenses: These lenses use an infrared sensing module to determine the distance to the subject.

Slow versus fast lens: Lenses are classified as to how much light they let in. An f/1.4–f/2.8 lens will allow large amounts of light in and thus is a fast lens. An f/4.0 and larger lenses will allow in small amounts of light and thus are slow.

Exposure level indicator: This is an indicator that allows the photographer a visual representation of the optimum exposure based on the camera functions (Figure 4.3).

Diaphragm: This controls the amount of light that penetrates through the lens. The f-stop ring on the lens controls the size of the opening of the diaphragm. The relative size opening of the diaphragm is called the *aperture*. The aperture size is expressed in fractions, known as *f-stops*.

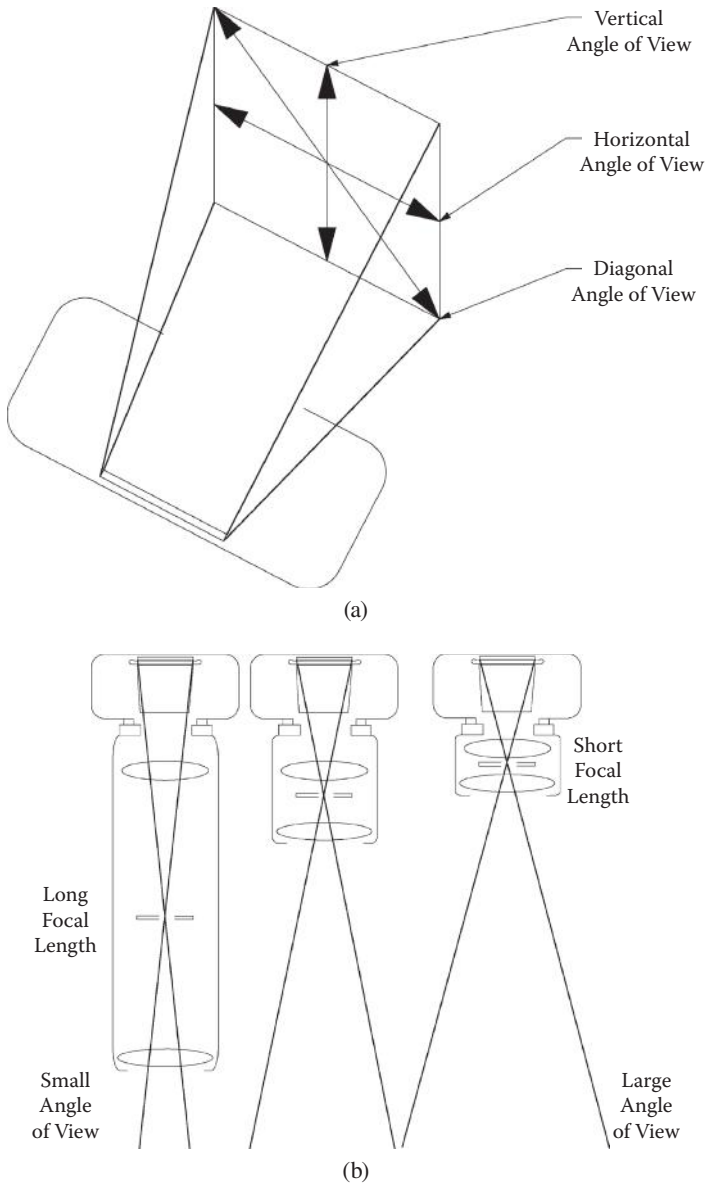


FIGURE 4.1 (a) Illustration of the three possible AoV measurements. (b) Illustration of the different AoVs based on the lens (wide angle, normal, and telephoto).

Exposure meter: This is used for measuring the reflected light or the incident light the camera will read. All cameras have built-in exposure meters, but they only read the reflected light, i.e., the light reflected back to the camera from the surface. Handheld exposure meters will read both. They will give you the shutter speed and lens aperture setting needed for that particular exposure. The handheld exposure meter will produce a better exposure reading than the one built into the camera. The human eye is extremely inaccurate in the process of determining the correct exposure. An exposure meter is far more accurate than the human eye for the purpose of determining exposure. The eye of the meter will remain open all the time (maintains a constant setting) to indicate the exact intensity of light.

When to use an exposure meter: The exposure meter is used in very low light, very light and dark areas in a crime scene, and/or when testing another meter's performance.

Camera built-in light meter:

Spot meter: The type of metering that takes its reading from a narrow angle of view. This is good for bright objects in the angle of view that are really not the focus of the photograph.

Center-weighted meter: This system takes the metering of the entire angle of view into account, but it gives greater priority to the center of the angle of view. This works well when the main subject of the photograph is centered in the frame. Use this when the subject is not in the center of the frame. Position the camera so the subject is

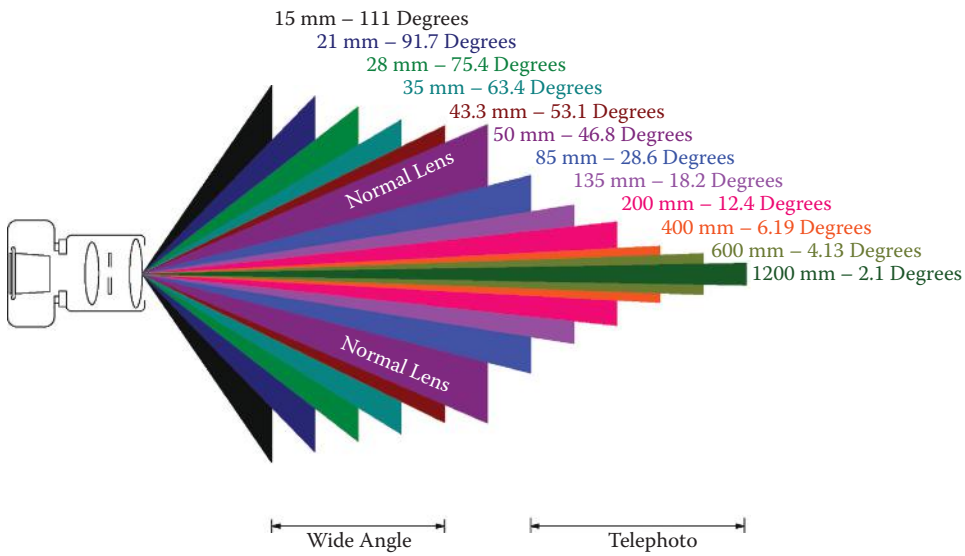


FIGURE 4.2 Illustration of the actual angle of view associated with various focal lengths.

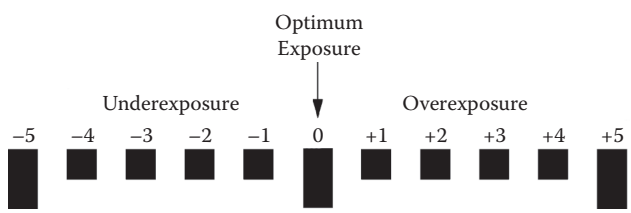


FIGURE 4.3 Exposure level indicator.

in center of frame. Obtain your meter reading and push the exposure lock button. Recompose your photograph. Take the photograph.

Matrix meter: This system divides the angle of view up into many smaller areas, segments, or quadrants. It may be divided into 5 to 45 different areas. Each area is independently metered. The meter uses a computerized algorithm to determine the best exposure value.

Image sensor: This is the film type for digital cameras. They are not all made the same. The size affects the amount of information each image is capable of storing. A CCD image sensor is a charge-coupled analog chip. Light strikes the chip and creates a small electrical charge on each photo sensor. A CMOS (complementary metal-oxide semiconductor) image sensor is an active pixel sensor that uses a semiconductor process. Photo sensors convert light passing through the lens into a voltage. Figure 4.4 illustrates the differences between a full-frame 35 mm or digital image sensor and the various digital image sensors that are smaller than full frame.

CCD versus CMOS: A CCD sensor is more susceptible to vertical smear from bright light sources and is the more mature of the two technologies. The CMOS has fewer components, uses less power, provides faster readout than CCD, and is less expensive to manufacture.

White balance: Light has temperature, more accurately a color temperature. It is the measure of the quality of the light source based on the ratio of the amount of blue light to red light. Low color temperatures shift light toward the red, while high color temperatures shift light toward the blue. Color temperature is a way of measuring the quality of the light source on the ratio of the amount of blue light to the amount of red light; the green light is simply ignored. Physicists have placed metal in vacuum and applied heat to the metal. They observed that at 2,000 K the metal was red and at 10,000 K the metal was blue. Lower light temperatures 2,000 K to 4,000 K is "warmer" light with more red tones. Higher light temperatures were 7,000 K to 14,000 K with "cooler" light and bluer tones. Human eyes are capable of adjusting to the different temperature ranges. Digital cameras, on the other hand, find it difficult and require a global adjustment of the intensities of the three primary colors: red, blue, and green.

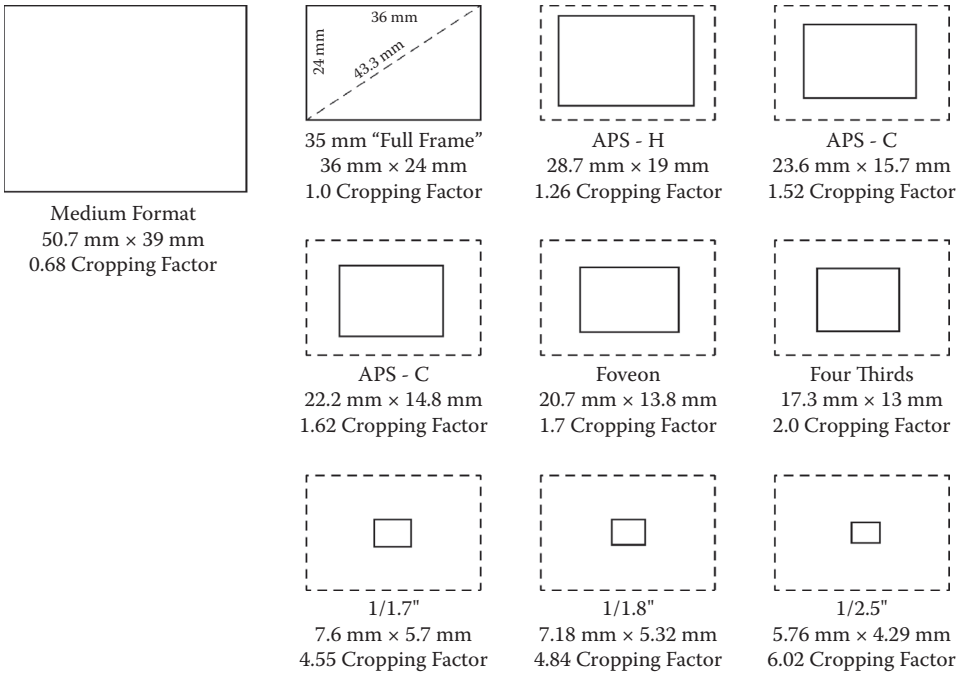


FIGURE 4.4 Illustration of the various sizes of digital image sensors as compared to the 35 mm film standard.

PHOTO EXERCISE 4.1

White Balance				
Photographer's Name:	**Camera Make:**	**Camera Model:**	**Camera Serial No.:**	
Camera Mode: Program Mode	**Shutter Speed:** As Determined	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod in a room with the lights on.
2. Position the camera in one corner of the room and direct the lens to the opposite corner (catty-corner) of the room.
3. Set the focus to manual and focus on the camera.
4. Place the white-balance setting to the first setting in the white-balance selection screen.
5. Once the image is recorded, adjust the setting for the next white-balance setting and repeat the exercise for each possible white-balance setting.
6. Repeat the exercise outside in a bright sunlight area.

Indoor Exercise		**Outdoor Exercise**	
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:
White Balance Setting	Overall Color of Image:	White Balance Setting	Overall Color of Image:

Discussion:
Describe the difference between the indoor exercise and the outdoor exercise.

CROPPING OR MAGNIFICATION FACTOR

This is a term that relates the ratio of the dimensions of a camera's imaging area to a reference format. In digital photography, this reference format is the 35 mm film image area. To achieve a field of view of 30.1 ft (the APS-C image sensor) with a subject at 300 ft, you need a 432 mm lens for the 35 mm format, and for the 22.5 ft (the 4/3 image sensors), you would need a 576 mm lens. By changing the lens, the image is now larger. Therefore, the same focal length lens will produce different images, depending on the sensor size. This difference between common digital and 35 mm film sensor sizes is referred to as the *cropping factor* or the *multiplier effect*. A crop factor is the ratio of the dimensions of a camera's imaging area compared to a reference format, which most often is the 35 mm film format. The formula for determining the cropping factor (CF) is:

$$CF = diag_{35\ mm}/diag_{sensor}$$

where

CF for APS-C = 43.3/30.1 = 1.44×
CF for 4/3 sensors = 43.3/22.5 = 1.92×

For example, the cropping factor for a Nikon D1X is reported as 1.4. Thus a 300 mm lens on the D1X will frame an image the same as if a 450 mm lens was used on a 35 mm film camera. The Olympus E-500 has a reported cropping factor of 2×; thus a 300 mm lens on the E-500 will frame an image the same as if a 600 mm lens was used on a 35 mm film camera.

This seems to work out well if you are about to purchase a telephoto or zoom lens. You may purchase a 300 mm lens, with a 2× cropping factor, essentially making the lens a 600 mm lens (as if it were used on the 35 mm film format). The disadvantage occurs in macro or close-up photography. If you were in need of a 7 mm focal length lens for the Olympus E-500, the 7 mm–14 mm lens would work ideally, until you factor in the cropping factor. This lens now becomes a 14 mm–28 mm lens. If your plans are to do a lot of close-up photography, it would do you better to spend the extra money and purchase cameras with larger image sensor formats.

This is not a magnification ratio, and it should never be expressed as such. Please do not take this to mean that the image is magnified the same as a 450 mm lens or 600 mm lens on a 35 mm film camera. The image sensor size has changed the field of view and the angle of view, not the magnification. If you were to use different sizes of film, other than 35 mm, you would observe the same effects. Another point of clarification is on the focal lengths. A lens with 300 mm focal length will always be 300 mm, no matter what camera the lens is on. It is the image sensor that affects the field of view, which ultimately affects the perceived focal length of the lens to be different from what is stated on the lens.

Lens specifications usually include the *angle of coverage*. The angle of coverage is the angle of projection by the lens onto the focal plane. This refers to the circular image of acceptable quality formed behind the lens at infinity focus. If the angle of view exceeds the angle of coverage, vignetting (a reduction of an image's brightness or saturation at the periphery compared to the image center) will occur. The angle of coverage is not dependent on the sensor size.

Angle of view revisited: Earlier in the chapter, we discussed the angle of view (AoV) and how it was directly related to focal length. The previous discussion about image sensors and cropping or magnification factor also plays a critical role in the angle of view. Figure 4.2 illustrated the various focal lengths and their associated angles of view. Figure 4.5 takes that same illustration and modifies it to now include the values of the focal lengths with the associated angle of view for the APS-H (Figure 4.5a), the APS-C (Figure 4.5b), the Foveon (Figure 4.5c), and the 4/3 (Figure 4.5d) image sensors. The 35 mm film focal lengths and angle of view are at the top of the diagrams, while the "adjusted" focal lengths for the four listed image sensors are at the bottoms of the diagrams.

FILES

File information and type: The word *pixel* is derived from two words: *picture element*. It is a dot, a square, or a hexagon, depending on the manufacturer of the image sensor.

File format: Raw files contain all the image information. JPEG is the typical file associated with digital photography. A TIFF image is the uncompressed file.

EXPOSURE COMPENSATION BUTTON

Exposure compensation allows the camera to adjust the exposure lighter and darker, with a range of 1–5 stops allowed, generally in 1/3 EV (exposure value) stops. There are several ways to adjust the exposure compensation. This button is another tool you can use to adjust the exposure compensation. This button does not work in auto mode or in manual mode.

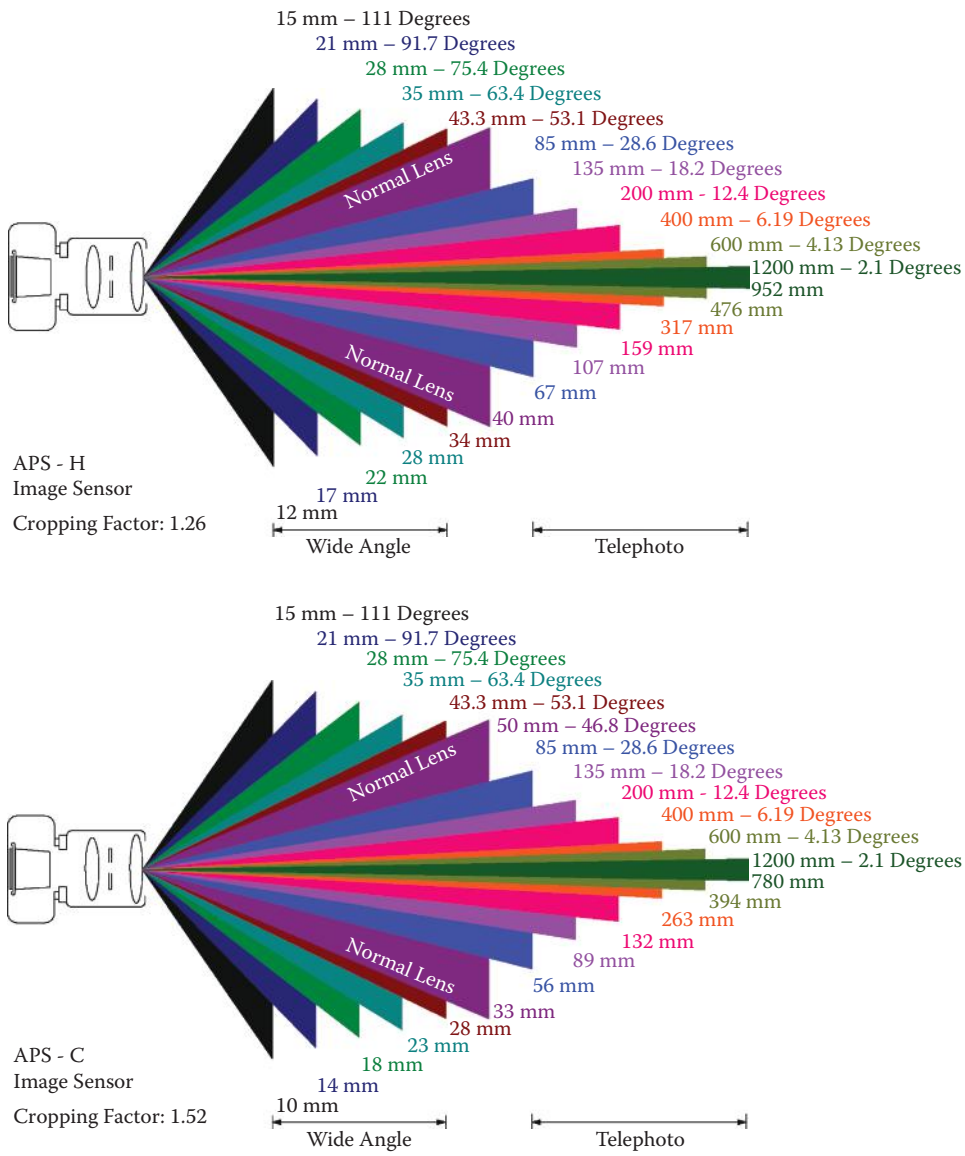
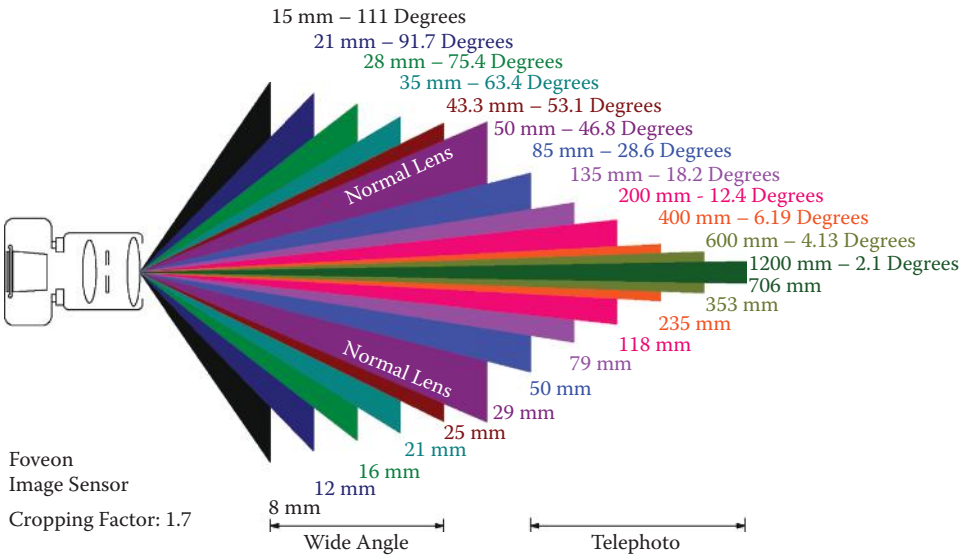


FIGURE 4.5 Illustration of the focal length and angle of view as they relate to the APS-H, the APS-C, the Foveon, and the 4/3 image sensors. *(continued)*



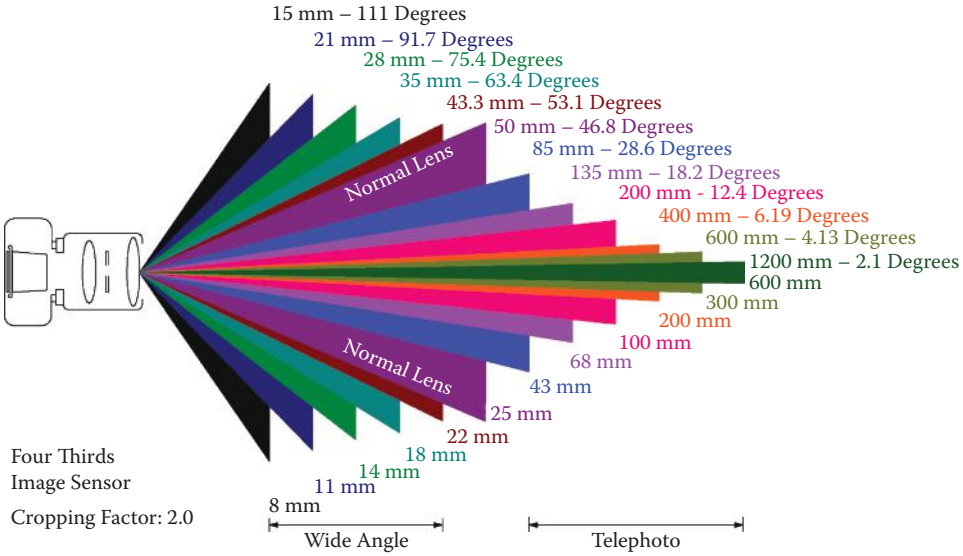


FIGURE 4.5 (continued) Illustration of the focal length and angle of view as they relate to the APS-H, the APS-C, the Foveon, and the 4/3 image sensors.

PHOTO EXERCISE 4.2

Exposure Compensation

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Program Mode	**Shutter Speed:** As Determined	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod in a room with the lights on.
2. Position the camera in one corner of the room and direct the lens to the opposite corner (catty-corner) of the room.
3. Set the focus to manual.
4. Dim the light so the room is mostly dark.
5. Take the photograph.
6. Adjust the exposure compensation to +1 and retake the photograph.
7. Adjust the exposure compensation to +2 and retake the photograph.
8. Adjust the exposure compensation to +3 and retake the photograph.
9. Adjust the exposure compensation to +4 and retake the photograph.
10. Adjust the exposure compensation to +5 and retake the photograph.
11. Adjust the exposure compensation to –1 and retake the photograph.
12. Adjust the exposure compensation to –2 and retake the photograph.
13. Adjust the exposure compensation to –3 and retake the photograph.
14. Adjust the exposure compensation to –4 and retake the photograph.
15. Adjust the exposure compensation to –5 and retake the photograph.
16. The exercise may be repeated outside.

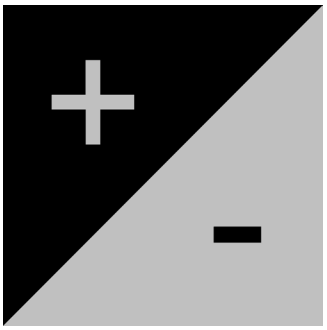


FIGURE 4.6 Shows a common stamp on the exposure compensation button.

SHOOTING MODES

Automatic mode (A) allows the camera to make all the choices for

1. Shutter speed
2. Aperture
3. ISO
4. White balance
5. Flash

Avoid using this mode for crime scene photography.

Program mode (P) is similar to auto mode except you have more control in the following areas:

1. Flash
2. ISO
3. White balance, etc.

This is an ideal mode to begin to learn the camera, understanding the ultimate goal is using the camera in full *manual mode*.

Aperture priority mode (A or Av) allows the photographer to choose the aperture, and the camera chooses all other settings. This is the next logical mode to progress to after program mode on your way to manual mode.

Shutter priority mode (S or Tv) allows the photographer to choose the shutter speed, and the camera chooses all other settings (Tv = time value).

Manual mode places the photographer in full control of the camera, where the photographer makes all the settings. This is your ultimate goal in understanding the camera.

Macro mode allows the photographer to move closer to the subject of the photograph. Focusing may become difficult at very close distances. Depth of field is reduced, and in some cameras it is reduced to mere millimeters.

ADDITIONAL EQUIPMENT

Flash units include standard and slave and other types.

A tripod should be capable of adjusting to multiple positions.

A remote control device is used to remotely press the shutter button.

A shutter lock cable on a 35 mm film camera is used to hold the shutter open. The shutter will remain open as long as the cable is locked.

A PC cord allows the flash to be removed from the hot-shoe slot and still allow the flash to remain connected to the camera.

Diffusers are devices that assist in making the light diffuse reflections.

Reflectors are used to reflect light onto the object of the photograph. Some are made in multiple colors.

Viewfinder cover prevents light from entering the viewfinder, which affects the camera's light meter.

A lens hood minimizes the amount of light that enters the lens outside of the lens angle of view, which causes lens flare.

Cleaning equipment is used to clean lenses, and other components.

PHOTO EXERCISE 4.3

Depth of Field

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** See Below	**ISO:** 100	**Focal Length:** 28 mm and 50 mm

Directions:

1. Place the camera on a tripod.
2. Photograph 25 objects that are 1 foot apart, with the nearest object to your position being 1 foot away.
3. Position the camera 1 foot from the nearest object and where all objects are visible in every picture.
4. Focus on the tenth object.
   a. Depth of field f/4
   b. Depth of field f/5.6
   c. Depth of field f/8
   d. Depth of field f/11
   e. Depth of field f/16
   f. Depth of field f/22
5. The exercise is repeated at a 50 mm focal length.

Discussion:
Describe the difference between the various apertures and what is in focus and what is not in focus.

What were the hyper-focal distances for the various f/stops?

f/4.0	f/5.6	f/8	f/11	f/16	f/22

PHOTO EXERCISE 4.4

Stopping Motion

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Shutter Priority	**Shutter Speed:** See Below	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** 28 mm and 50 mm

Directions:

Vehicles parallel

1. Place the camera on a tripod in a safe location near a relatively busy street.
2. Position the camera parallel to the vehicles so that the vehicles closest to the camera are approaching the camera.
3. Photograph the vehicles in the lane closest to the curb if possible.
4. The exercise is repeated using a 50 mm focal length.
   a. Stopping motion S/S 1/4th (parallel subject)
   b. Stopping motion S/S 1/8th (parallel subject)
   c. Stopping motion S/S 1/15th (parallel subject)
   d. Stopping motion S/S 1/30th (parallel subject)
   e. Stopping motion S/S 1/60th (parallel subject)
   f. Stopping motion S/S 1/125th (parallel subject)
   g. Stopping motion S/S 1/250th (parallel subject)
   h. Stopping motion S/S 1/500th (parallel subject)

Vehicles perpendicular

1. Rotate the camera 90° so the camera is not perpendicular to the street.
2. Photograph the vehicles in the lane closest to the camera.
3. Repeat the exercise for vehicles in the furthest lane from the camera.
4. The exercise (both the closest and furthest vehicles) is repeated using a 50 mm focal length

a. Stopping motion S/S 1/4th (perpendicular subject)
b. Stopping motion S/S 1/8th (perpendicular subject)
c. Stopping motion S/S 1/15th (perpendicular subject)
d. Stopping motion S/S 1/30th (perpendicular subject)
e. Stopping motion S/S 1/60th (perpendicular subject)
f. Stopping motion S/S 1/125th (perpendicular subject)
g. Stopping motion S/S 1/250th (perpendicular subject)
h. Stopping motion S/S 1/500th (perpendicular subject)

Discussion:

What was the first shutter speed where the vehicles were in sharp focus?

Parallel 28 mm:	Parallel 50 mm:	Perpendicular 28 mm closest:	Perpendicular 50 mm closest:	Perpendicular 28 mm furthest:	Perpendicular 50 mm furthest:

PHOTO EXERCISE 4.5

ISO

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Manual Mode	**Shutter Speed:** 2 in.	**Aperture:** f/8	**ISO:** See Below	**Focal Length:** Normal Lens

Directions:

1. Make sure the camera's noise stabilizer and image stabilizer are turned off.
2. Place the camera on a tripod in a room capable of being darkened.
3. Leave the door open to allow hallway light to enter the room.
4. Position the camera in one corner of the room and direct the lens to the opposite corner (catty-corner) of the room.
5. Set the focus to manual.
6. Turn the room lights off.
7. If there are windows, turn the shades to dim the light coming into the room.
   a. ISO 100
   b. ISO 200
   c. ISO 400
   d. ISO 800
   e. ISO 1600
8. The exercise is repeated with the camera's image stabilizer and noise stabilizer turned on.

Discussion:
Describe the difference between the images taken with the stabilizers turned off and when they were turned on.

What was the first image where noise appeared in the image?

Stabilizers Off	Stabilizers On:

f/Stop	Shutter Speed	f/Stop	Shutter Speed
f/1	1/8000	f/8	1/125
f/1.4	1/4000	f/11	1/60
f/2	1/2000	f/16	1/30
f/2.8	1/1000	f/22	1/15
f/4	1/500	f/32	1/8

FIGURE 4.7 The various f/stop numbers as they pertain to shutter speed.

EXPOSURE

18% reflectance gray: This is what digital cameras base their color on. White areas are too bright (brighter than the 18% reflectance gray), and therefore the camera tries to underexpose the image, e.g., the snow becomes gray. Black areas are too dark (darker than the 18% reflectance gray), and therefore the camera tries to overexpose the image, e.g., areas become a dark gray rather than black.

Exposure revisited: Mathematically speaking, each exposure has a specific value. By making the correct combinations, we can see that several exposure settings would have the same exposure value (Figure 4.7). The tradeoff is depth of field.

Over- and underexposure: Overexposure is too much light. Underexposure is too little light.

LIGHT

Understanding light is one major hurdle a photographer can undertake. *Hard light* applies to sunlight and other light sources that cast very distinct shadows. Soft light occurs when the light source casts light, diffuse shadows.

Light principles: Understanding these principles assists in understanding how light behaves. The three basic principles include

1. The size of the light source
2. The type of reflection the light source produces
3. Light angles

Brightness, color, and contrast: Photographer's description of light includes brightness, color, and contrast. Brightness is the single most important quality of light. The brighter light allows the use of smaller apertures sizes and/or faster shutter speeds. Color has a temperature range that photographers use to describe light based on ranges, i.e., warm light and cool light. Contrast describes the characteristics of the shadows created by the light. Hard contrast shows distinct shadow borders, and soft contrast shows diffuse, less distinct shadow borders.

Light versus lighting: A photograph is the recording of light. Lighting is the relationship between (a) the light, (b) the subject, and (c) the viewer.

Effects of light on a surface: Transmitted light is light that passes through a surface. It is difficult to photograph, since light passes through the surface. Absorbed light is light that is neither reflected nor transmitted. Reflected light is light that bounces off the surface.

Types of reflection: Light is generally reflected off a surface by diffuse reflection or direct reflection. The type of surface may produce some or all of these types of reflection. The proportion of types will vary from surface to surface.

Direct reflection: This light reflection differs from diffuse reflection in that the light reflects off the surface in approximately the same angle as the light rays that struck the surface. That is, the angle of incidence equals the angle of reflectance. Figure 4.8 is an illustration of direct specular reflection.

Diffuse reflection: This type of lighting reflection is not uniform over the entire surface, which causes the light to be reflected randomly in all directions. These types of reflections occur due to the surface changing the direction of the light. This is not to be confused with diffuse lighting. The source determines the type of light, while the surface determines the type of reflection. Any light source can produce any reflection, depending on the surface. Neither the size of the light source nor the angle of the light source affects the appearance of the diffuse reflection. In diffuse reflection, the closer the light source is to the surface, the brighter the subject becomes and the lighter the subject appears in the photograph. Figure 4.9 is an illustration of diffuse reflections.

When comparing Figures 4.8 and 4.9, we see an obvious difference between the two. The amount of light that illuminates an intended subject of a photograph will differ between the two as well. The light coming from diffuse lighting will be softer and less harsh than direct light simply due to less light reaching intended target. A common example of this type of reflection is light bouncing off ceiling tiles.

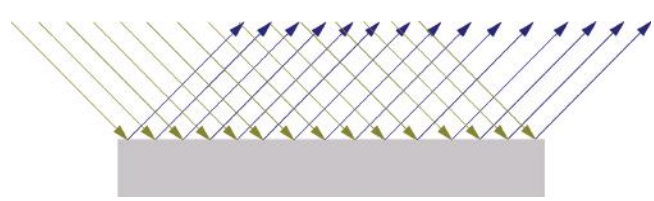


FIGURE 4.8 Illustration of direct specular reflection.

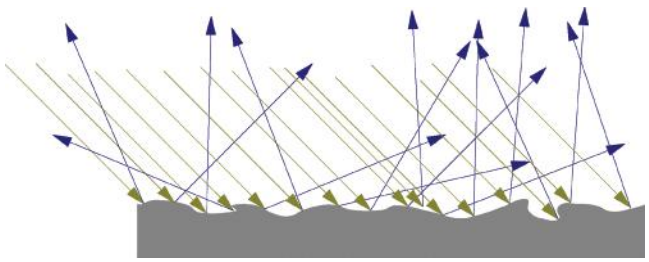


FIGURE 4.9 Illustration of diffuse reflection.

Refraction: This is the change in the direction of the light wave due to a change in velocity. It occurs when light passes through one medium to another.

Diffraction: Diffraction is the bending of light around corners. It is seen in cameras at very small apertures (large f/number). Therefore, limit the f/stop to f/22 or smaller (such as f/22, f/16, f/11). Avoid f/stops above f/22 (smaller openings), as these ultimately result in blurring of the image and loss of detail.

LIGHTING ANGLES

Our previous discussion on the way that light interacts with a particular surface essentially was discussing light as a single ray of light. Figure 4.10 illustrates this point. Since we are unable to produce a light source strong enough for this to occur, we must use light sources with numerous light rays. In doing so, we also increase the number of angles at which light strikes a surface and, subsequently, is reflected off of it. However, these angles are not infinite; they are essentially dependent on the size of the light source. We will further narrow our discussions about light angles to simple direct reflections.

Take a glass surface, for example. Remember that the angle of incidence is approximately equal to the angle of reflectance on this type of surface. So if we want to place the camera such that we do not capture any directly reflected light in the image, we would want to place the camera so that it is not in the angle of reflectance. If camera placement is limited due to space, then the light source may be moved. Figure 4.11 illustrates the angles that would normally be seen. Figure 4.11a is using a small light source, and Figure 4.11b is using a much larger light source.

If the photographer wishes to capture direct reflection, then simply placing the camera within the angle of reflectance

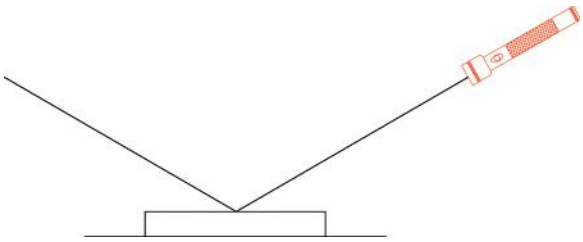


FIGURE 4.10 Illustration of the single ray of light.

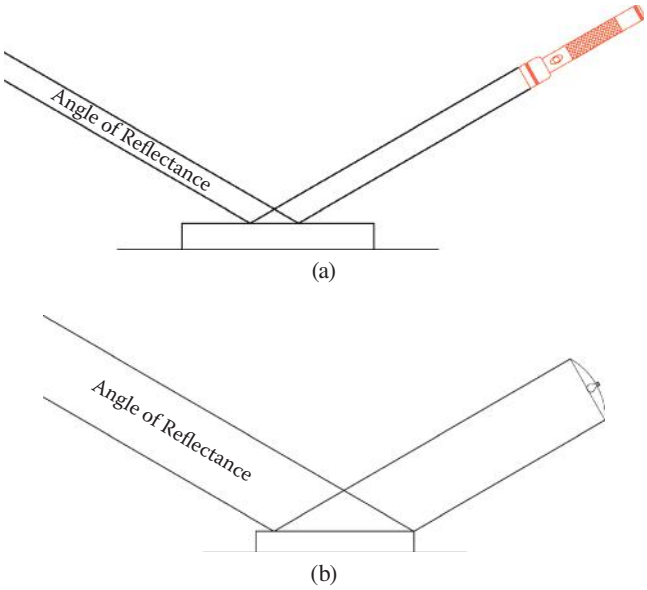


FIGURE 4.11 Illustration of the range of angles available from light sources: (a) the range of angles from a small light source such as a flashlight; (b) the range of angles available from a larger light source, more common to photographic studios.

will ensure that this reflection is captured in the image. If this is not desirable, then the photographer must ensure that the camera is not inside these angles. Another way to examine the angles is to replace the light source in Figure 4.8 with a camera. Now the placement of the light has the same effect, that is, if the light source is within the angles, then direct reflection will be seen, and if the light source is outside the angles, then direct reflection will not be seen.

DISTANCES

Camera Distance

When we examine the camera in place of the light source, we see that there are other factors that affect this group of angles. First is the focal length of the lens that is used. The normal lens (50 mm for a 35 mm film camera) focal length has a smaller horizontal field of view than, say, a wide-angle lens. Therefore, the angles that will produce direct reflectance are smaller in the normal lens than in the wide-angle lens.

Next is the distance the camera is from the surface. The farther the camera is away from the surface, the narrower the angle is, and thus the closer the camera is to the surface, the wider the angles become. Figure 4.12 illustrates this point. Notice how much larger the angles are in Figure 4.12a, where the camera is close to the surface, as opposed to Figure 4.12b, where the camera is farther away. These images should not be misinterpreted as instructions to place the camera farther away and using different lenses to take close-up photographs. It is intended to indicate that as the camera comes closer to the subject, the greater are the light angles.

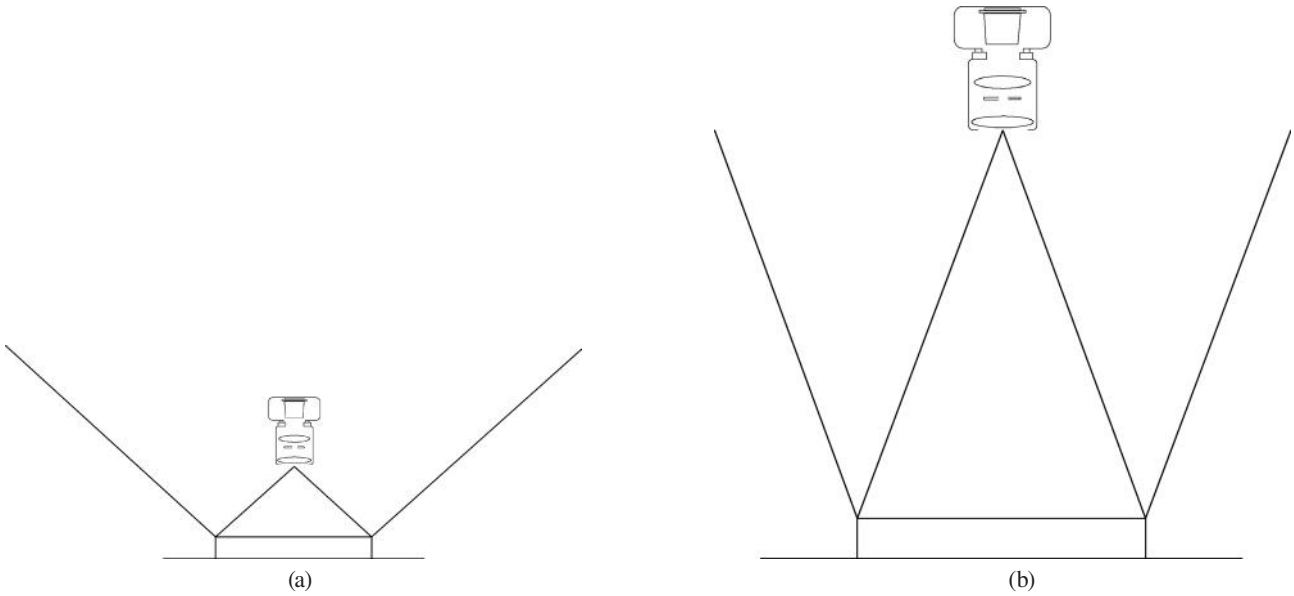


FIGURE 4.12 Illustration of the effects of the angles on the placement of the camera: (a) the angles when the camera is close to the surface; (b) the angles when the camera is farther away.

Light Distance

The farther away the light is from a surface with diffuse reflection, the dimmer the surface will be. And likewise, the closer the light source is, the brighter the surface will be. Shallow angles from the light source will result in diffuse reflections and will avoid direct reflections. The downside to this type of lighting is that one side of the surface will be brighter than the other side. This may be corrected by simply moving the light source farther away from the surface while keeping the original angle the same. Figure 4.13 illustrates the placement of the light source. In Figure 4.13a, the light source is close to the surface, which results in an uneven illumination of the surface. Figure 4.13b illustrates that moving the light source farther back while maintaining the same angle results in a more even illumination over the surface.

Light Source Closest to Camera

For the most even illumination, the light source should be as close as possible to the camera. But we have seen from previous discussions that placing the light source near the camera also puts the light source inside the angles that would cause direct reflections. Then how are we to place the light source near the camera without causing any direct reflections? There are several options that would accomplish this task. The first option is to use a lens with a longer focal length. Using a longer focal length lens allows us to move the camera farther back while focusing on the image to obtain the same image size. Remember that moving the camera farther back causes the range of angles to narrow.

Another option is to use a polarized filter. By placing a polarized cover over the light source, you create polarized

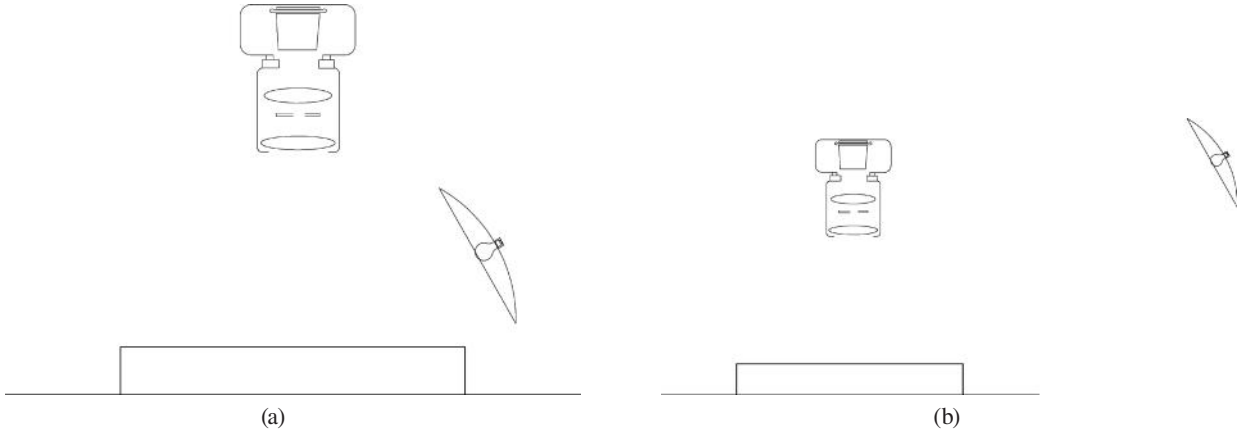


FIGURE 4.13 Illustration of the placement of the light source and the effects of the illumination: (a) the light source close to the surface, resulting in an uneven illumination; (b) simply moving the light source back from the surface, resulting in a more even illumination of the surface.

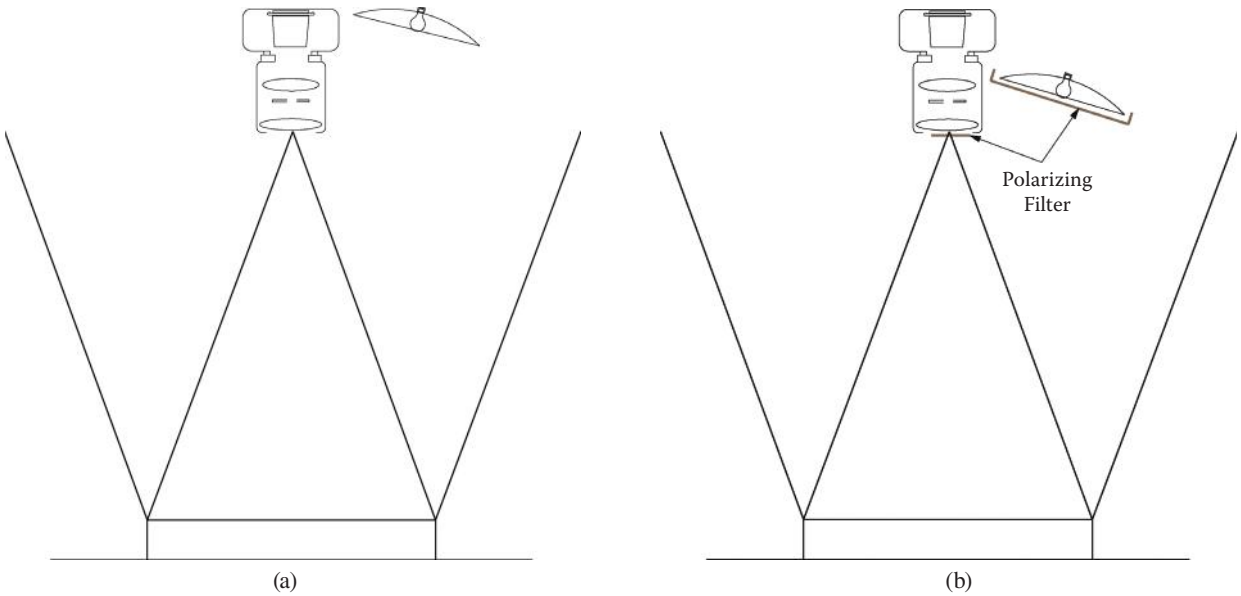


FIGURE 4.14 Illustration of the placement of the light source near the camera: (a) illustration of placing the light source near the camera also places the light source inside the range of angles that would create direct reflections; (b) illustration of one option used to reduce the direct reflections by using a polarized cover over the light source and polarized filter over the camera lens.

light. The reflections will now (in theory) be polarized reflections as opposed to direct reflections. If we then place a polarized filter over the camera lens, we are able to capture the image with no reflections at all. Figure 4.14 is an illustration of the use of a polarized filter over the light source and the camera lens.

This option, again, is in theory. No filter is perfect; therefore, some polarized reflections will pass through the lens. Another disadvantage is the fact that, when something is placed over the camera lens, there is a price to be paid. Here, the price is exposure. Most polarized filters in theory reduce the exposure by two stops. This means that in order to get the same exposure value, you must increase the exposure by two stops.

In practice, polarized filters may reduce the exposure by as many as six stops. Another disadvantage when using polarized filters is the heat damage that is generated from the light source. If the filters reduce the exposure by as many as six stops, the light must be going somewhere. The filter is actually absorbing the light. When the filter absorbs the light, internal heat is generated in the filter. This is because the light cannot just disappear. The light is dissipating by generating heat in the filter. Over time, this heat causes physical damage to the filter. Therefore, if this is an option you choose to use, it should not be used all the time. Otherwise, you will be spending lots of money on polarized filters.

The Importance of Light

Artistic lighting uses the angles of the light to set moods, which may result in a distorted photograph. Crime scene photographers use lighting to reveal textures and other areas on a surface.

Using Direct Reflections

Diffuse reflections or shadows reveal texture. Direct reflections on black surfaces may reveal texture on black surfaces. Diffuse reflections will not show texture on black surfaces.

PHOTO EXERCISE 4.6

Lighting Angles and Lighting Distances

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Program Mode	**Shutter Speed:** As Determined	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod.
2. Position the camera to a downward direction (floor or table).
3. Place a piece of glass on the floor under the camera.
4. Take a picture of the glass.
5. Position a flashlight or attach the external flash to the PC cord and place the flash next to the camera, illuminating the glass.
6. Retake the picture of the glass.
7. Reposition the light to an angle of approximately 30°.
8. Retake the picture.
9. Repeat steps 3–8 using
   a. Shiny metal
   b. Dull metal
   c. Mirror
   d. Piece of wood
   e. Piece of smooth shiny wood flooring
10. Place an object on the floor.
11. Illuminate the object at approximately 30°.
12. Hold the light close to the object, but just out of the angle of view.
13. Take the picture.
14. Move the light source 5 ft away.
15. Retake the picture.
16. Move the light source 10 ft away.
17. Retake the picture.
18. Move the light source 15 ft away.
19. Retake the picture.

(a) (b)

FIGURE 4.15 Photographs demonstrating Photo Exercise 4.7A: (a) is normal lighting, (b) is using a flashlight as fill lighting.

PHOTO EXERCISE 4.7A

Fill-Light Photography

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
Using flashlight or off-camera flash to fill light

1. Place an object on the top of a vehicle tire or chair under a table or desk.
2. Photograph the vehicle using direct flash.
3. Using a flashlight shine the light into the area illuminating the object.
4. Repeat the photograph using the fill-lighting technique.

(a) (b)

FIGURE 4.16 Photographs demonstrating Photo Exercise 4.7B: (a) is normal lighting and (b) is a partially overexposed photo showing the vehicle's wheel well.

PHOTO EXERCISE 4.7B

Fill-Light Photography: Alternative Method

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
Using the camera to fill light

1. Place the camera on program mode.
2. Place the lens into the wheel well and depress the shutter button halfway to meter the lighting conditions in the wheel well.
3. Record the aperture and shutter speeds.

Aperture:	**Shutter Speed:**

4. Remove the camera from the wheel well and set the camera to manual mode.
5. Set the metered aperture and shutter speeds. Take the photograph.

Discussion:
Describe the difference between using the flashlight to fill the light and using the camera to fill the light.

ADDITIONAL LIGHTING CONSIDERATIONS

Lens and camera flare: Light entering a digital camera lens must enter at almost a 90° angle. Otherwise, the lens and cameras may not be able to adequately deal with the light. Professional cameras have special interiors designed to deal with this issue.

Inverse Square Law: This is a mathematical relationship between the strength of the light that reaches the subject of the photograph and the distance the subject is from the light source. See Table 4.1 and Figure 4.17.

$$I = 1/d^2$$
$$D = \sqrt{(1/I)}$$

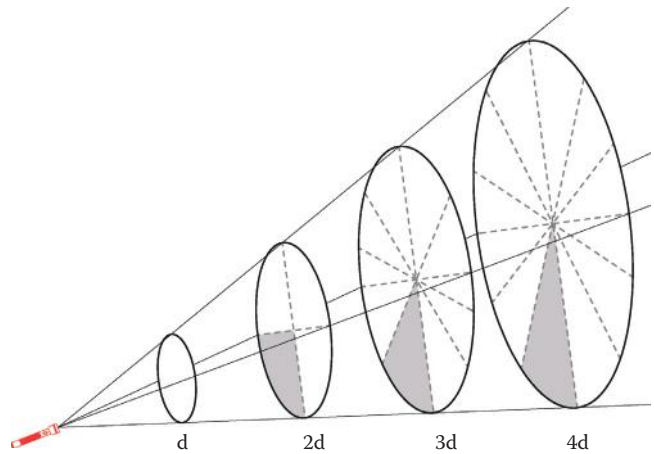


FIGURE 4.17 Illustration of inverse square law.

Light color and its importance: Our brains see light in a vast number of colors. The two types of standard lighting are

1. Tungsten light
2. Daylight

All other types are considered nonstandard lighting, such as fluorescent lightbulbs. Tungsten is a light source that has more of an orange tint and is the typical household lighting. Daylight is dependent on the time of day. Standard daylight is bluer, and normal daylight is 5500 K.

TABLE 4.1

1/2I	=	1.4d	1/256I	=	16d
1/4I	=	2d	1/512I	=	22d
1/8I	=	2.8d	1/1024I	=	32d
1/16I	=	4d	1/2048I	=	45d
1/32I	=	5.6d	1/4096I	=	64d
1/64I	=	8d	1/8192I	=	90d
1/128I	=	11d			

Color mix or unmixed: When confronted with multiple light sources, our eyes are able to compensate for the different colors. The camera, however, is not. Try to reduce the types of light sources to one kind.

Filters: There are different types of filters.

1. Polarized filter
2. Haze filter
3. Ultraviolet (UV) filter

Filters change the composition of the available light. A filter works differently in B&W mode as compared to color mode. Filter factors describe the effect that most filters reduce the amount of light that passes.

PHOTO EXERCISE 4.8

Fill the Frame

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Program	**Shutter Speed:** As determined	**Aperture:** As determined	**ISO:** 100	**Focal Length:** 28 mm

Directions:

1. Photograph different-sized items using a 28 mm focal length.
   a. Items the size of notebook paper
   b. Items the size of a standard light-switch cover
   c. Items the size of a shotshell headstamp
   d. Items the size of a rifle cartridge casing headstamp
   e. Items the size of a .45 cal cartridge casing headstamp
   f. Items the size of a fired projectile
   g. Items the size of a .22 cal cartridge casing
2. During the exercise, use an L scale and properly align the scale both along the major axis of the object as well as placing the scale at the appropriate height.

Discussion:

Describe the difference between the different-sized objects and the different focal lengths used. Discuss how close to the object your camera would allow you to get and still allow the camera to focus on the object.

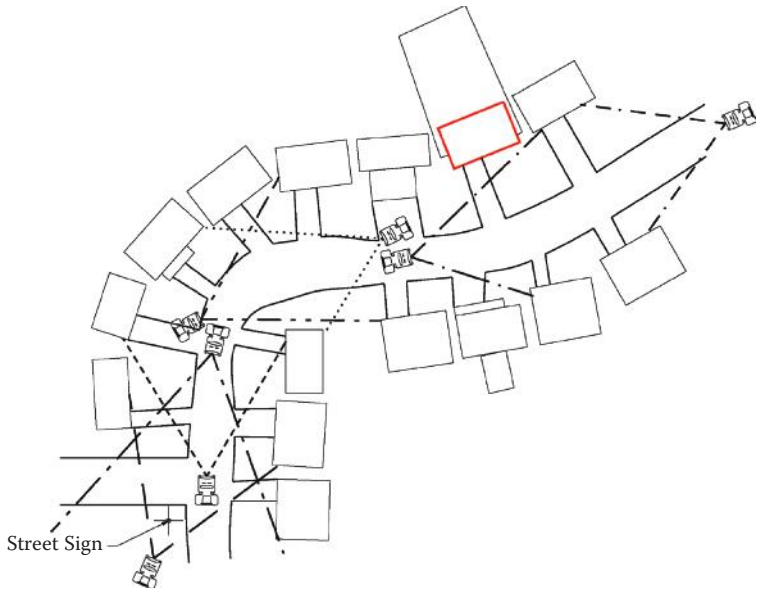
PHOTO EXERCISE 4.9

Crime Scene Documentation: Overall Exterior

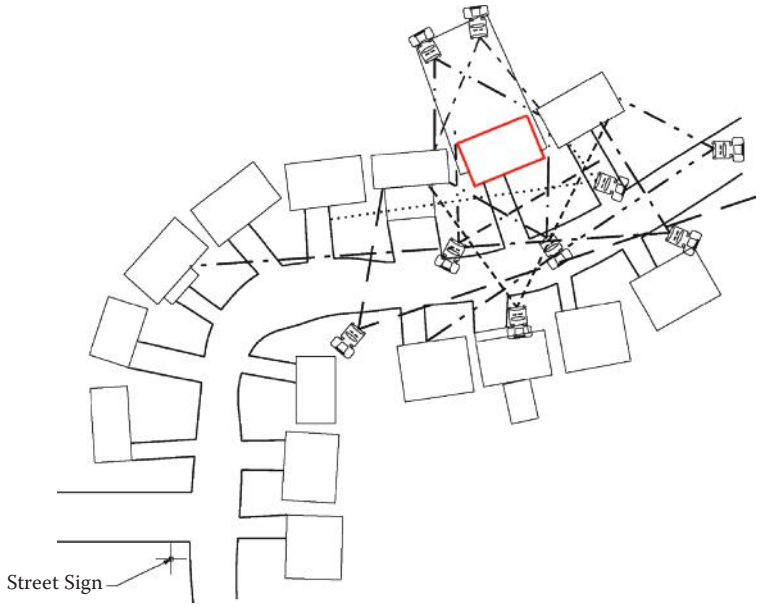
Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Begin from the nearest intersection or building sign showing an address.
2. Properly photograph the overall condition of an exterior scene.
3. This exercise may also be repeated during the night or low-light situations, requiring the use of a flash.



(a)



(b)

FIGURE 4.19 These illustrations demonstrate exterior photographs; (a) documenting up to a residence, (b) documenting around the residence.

PHOTO EXERCISE 4.10A

Crime Scene Documentation: Overall Interior Corner-to-Corner Approach

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Properly photograph the overall conditions of an interior of a crime scene.
2. The exercise is either repeated for photographing the individual room with the lights off, requiring the use of a flash, or if several rooms are to be photographed, the lights in one room should be off.

Interior photographs should be taken from a minimum of all corners in the room. When taking this set of images, ideally you should be able to see the ceiling, the floor, and the two walls that make up the corner you are focusing on. You then move around the room in either a clockwise or counterclockwise direction. There should be some detail on each wall that overlaps from one image to the next. This allows the linking of each image together within all the overall images. The corner-to-corner approach further documents the interior room by linking it together with the previous photograph.

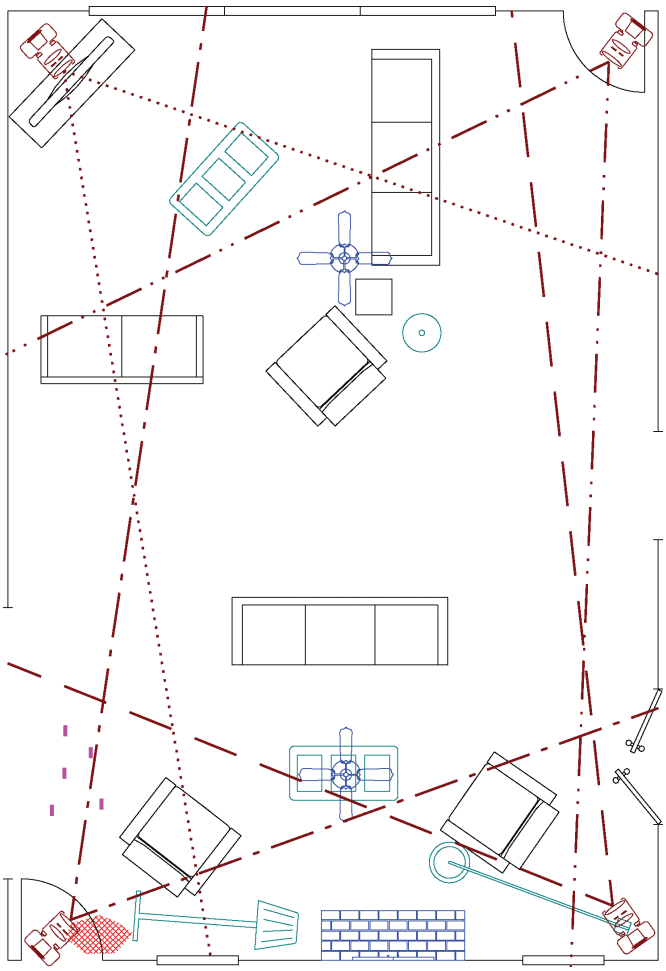


FIGURE 4.20 Illusrates the corner-to-corner approach to overall interior photographs.

PHOTO EXERCISE 4.10B

Crime Scene Documentation: Overall Interior Wall-to-Wall Approach

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Properly photograph the overall conditions of an interior of a crime scene.
2. The exercise is either repeated for photographing the individual room with the lights off, requiring the use of a flash or if several rooms are to be photographed, the lights in one room should be off.

The camera should be at a 90° angle to the wall. Items in the corners of the photographs may also appear to be closer to the wall than they actually are. The wall-to-wall approach will help alleviate the distortion. This series of photographs will be taken from the center of one wall while focusing on the wall on the opposite side of the room. If the wall is too large to fit into the field of view or if the room is very small, the wall may have to be broken down into smaller segments. Again, there must be some detail on each segment of the wall that overlaps with the images from the previous photograph.

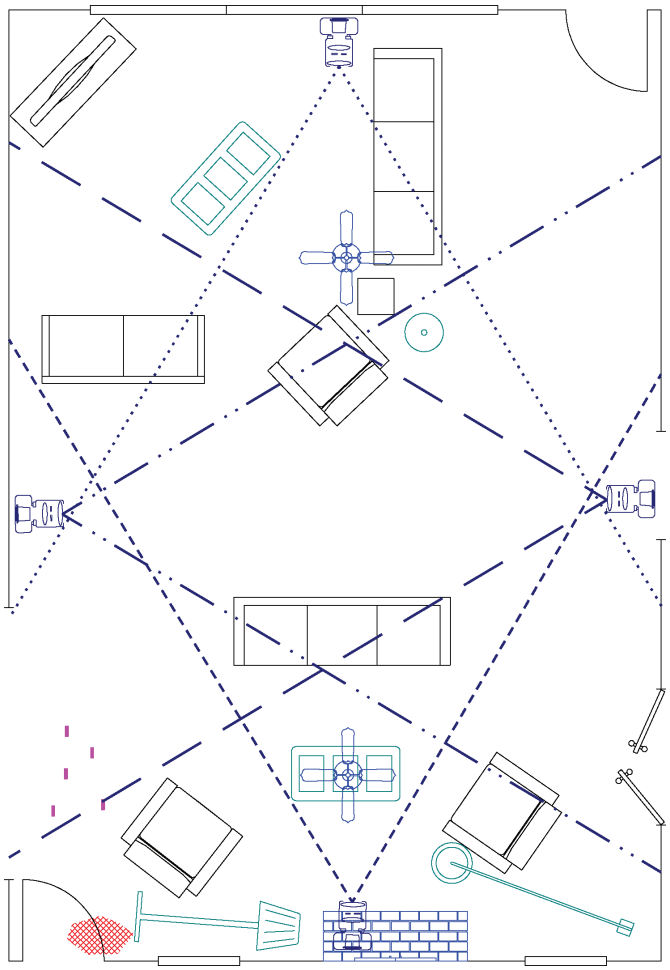


FIGURE 4.21 Illustrates the wall-to-wall approach to overall interior photographs.

PHOTO EXERCISE 4.10C

Crime Scene Documentation: Overall Interior Modified Approach

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Properly photograph the overall conditions of an interior of a crime scene.
2. The exercise is either repeated for photographing the individual room with the lights off, requiring the use of a flash, or if several rooms are to be photographed, the lights in one room should be off.

The overall photographs depicted in the corner-to-corner and wall-to-wall approaches are good general photographs. If the scene contains lots of furniture or other objects, they present an issue of perspective distortion. The modified approach combines the corner-to-corner and wall-to-wall approaches and adds a few additional photographs that will help minimize any distortion in perspective.

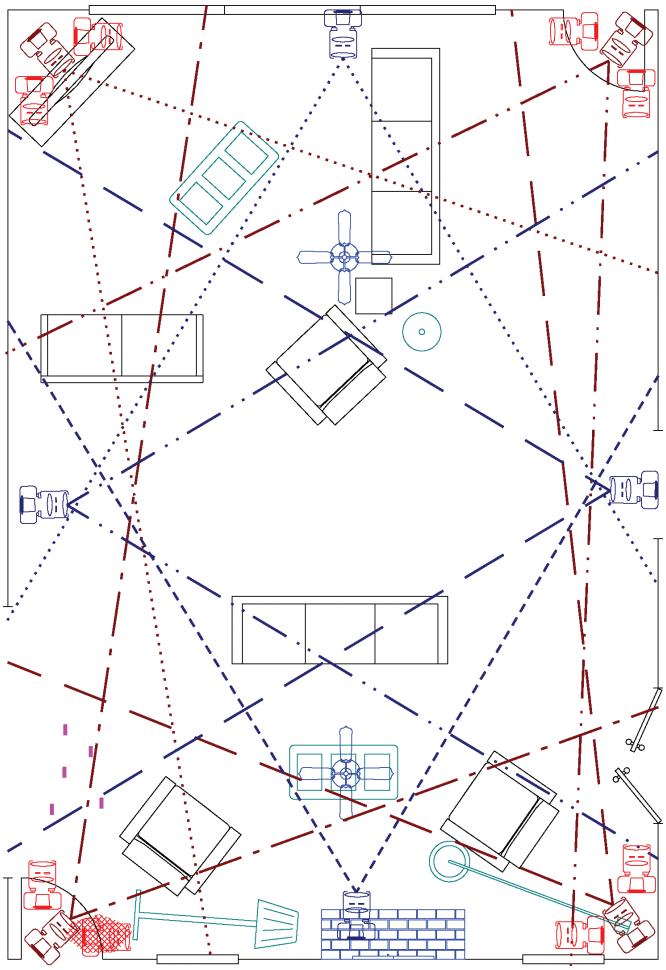


FIGURE 4.22 Illustrates the modified approach to overall interior photographs.

PHOTO EXERCISE 4.11

Evidence with and without Markers

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
Place several items of evidence in a room.

1. Take the appropriate midrange and close-up photographs of the evidence.
2. Place evidence markers next to each evidence item.
3. Repeat the process taking the appropriate midrange and close-up photographs of the evidence with the evidence markers.

This exercise may also be repeated during the night or low-light situations, requiring the use of a flash.

PHOTO EXERCISE 4.12

Vehicle Documentation

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Begin by taking overall photographs of the vehicle.
2. Start at the rear of the vehicle and then work around the vehicle in either a clockwise or counterclockwise direction, taking a photograph from each corner and each side of the vehicle
3. This is followed by a photograph of the tag and the registration decal on the tag.
4. A photograph of the VIN is also necessary.
5. Photograph the seals or the lack of any seals on the doors, the trunk and hood of the vehicle.
6. Photograph any parking decals or other stickers that may contain specifically identifiable numbers and/or photograph any visible damage to the vehicle.

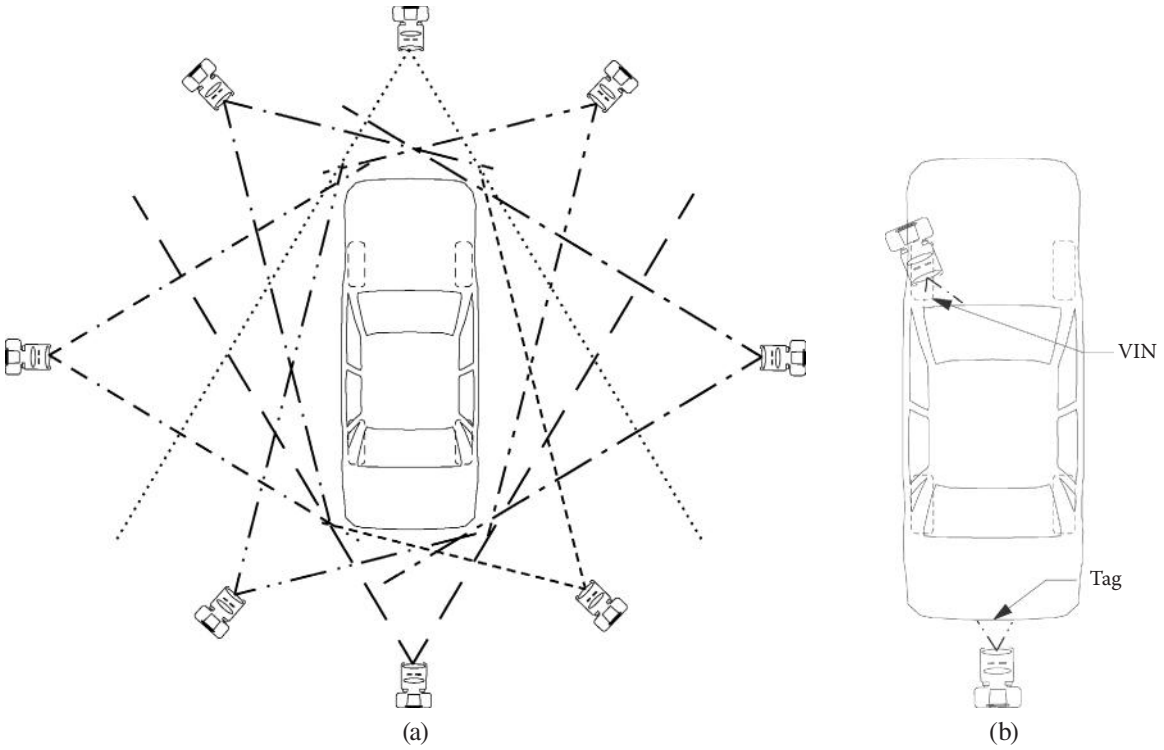


FIGURE 4.23 Figure 4.23 illustrates the necessary (a) overall vehicle photos and (b) the vehicle identification photos (VIN, tag, decals, etc.)

PHOTO LOG

Some agencies require the use of a photo log to document the photos that were taken during the processing of the scene. If your agency utilizes a photo log (see Figure 4.24), you may want to use that form along with these exercises. This provides you practice in completing the log after photographing a scene or evidence.

PC Cord

Simply having a camera will suffice for some of the exercises. Several items are necessary for the proper photographic documentation of a crime scene and any associated evidence. It is impossible to hold a camera still enough to take timed photographs. Simply depressing the shutter-release button may be all that is required to cause the image to blur. An external flash and PC cord are necessary to properly light an area such as a footwear impression to provide the correct shadowing. Some surfaces simply cannot be photographed using a direct flash; the external flash and PC cord also help to alleviate this issue.

FLASH PHOTOGRAPHY

A dedicated flash is designed to work specifically with a given camera. An automatic flash is one where the flash's sensors are used to measure the light. The flash will shut off when the sensor receives what it thinks is the proper amount of reflected light. It may shut off the flash prematurely. Manual flash requires the photographer must set all flash settings.

Main flash techniques used in the field:
- Direct flash
- Off-camera flash
- Bounce flash
- Fill flash
- Focused flash
- Multiple strobes
- Diffuser

Flash synchronization: Factory settings are generally around 1/180 s. At higher shutter speeds, flash may not properly sync with the camera.

Photo Log

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date Log Initiated:	Date Log Completed:
Officer Initiating Log:	Officers Maintaining Log:			
Camera Make:	Camera Model:	Camera Serial #:	☐ Film SLR ☐ Film Point and Shoot	☐ DSLR ☐ Digital Point and Shoot

File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
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Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
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Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
File No.:		Image Description:									
Aperture:	Shutter Speed:	ISO:	Exposure Compensation:	Focal Length:							
									Page:		of

FIGURE 4.24 Page from photo log.

PHOTO EXERCISE 4.13

Flash Photography: Testing the Flash

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

Parallel

1. Place objects at known distances away from the camera in an outdoor location.
2. The closest object should be 5 ft from the camera.
3. Place the objects at 5–10-ft distances for a total of 100 ft.
4. Place the camera on a tripod at the 5-ft distance from the first object.
5. Set the camera to aperture priority mode.
6. Set the appropriate aperture.
7. Use direct flash with no diffusion.
8. Set the flash mode to dedicated or automatic mode.
9. This exercise is designed to demonstrate how aperture effects the distance a flash will travel.
10. This exercise may be repeated in a room.
    a. f/4
    b. f/8
    c. f/11
    d. f/16
    e. f/22

Perpendicular

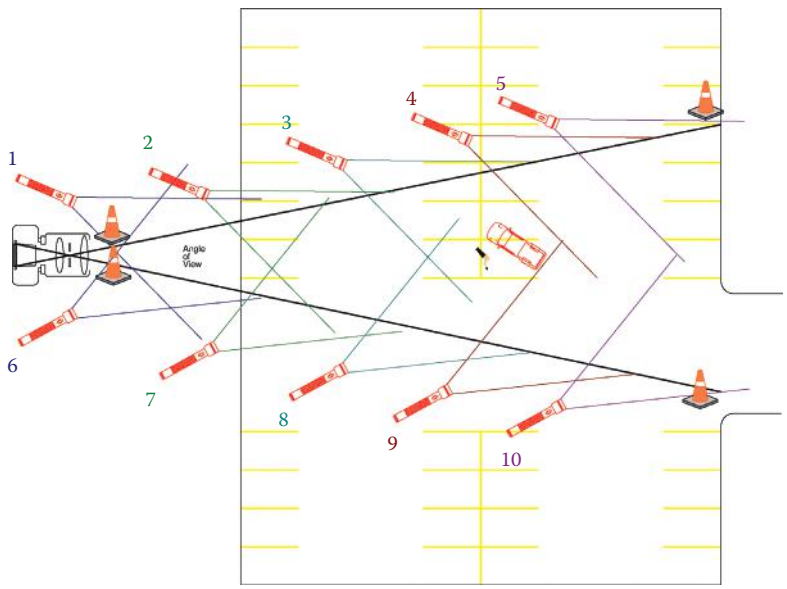
1. Place objects at known distances perpendicular to the camera in an outdoor location.
2. Place the objects at 5–10-ft distances for a total of 100 ft.
3. Place the camera on a tripod at a 25-ft distance from the center object.
4. Set the appropriate aperture.
5. Use direct flash with no diffusion.
6. Set the flash mode to dedicated or automatic mode.
7. This exercise is designed to demonstrate how aperture effects the width a flash will travel.
8. This exercise may be repeated in a room.
    a. f/4
    b. f/8
    c. f/11
    d. f/16
    e. f/22

PHOTO EXERCISE 4.14A

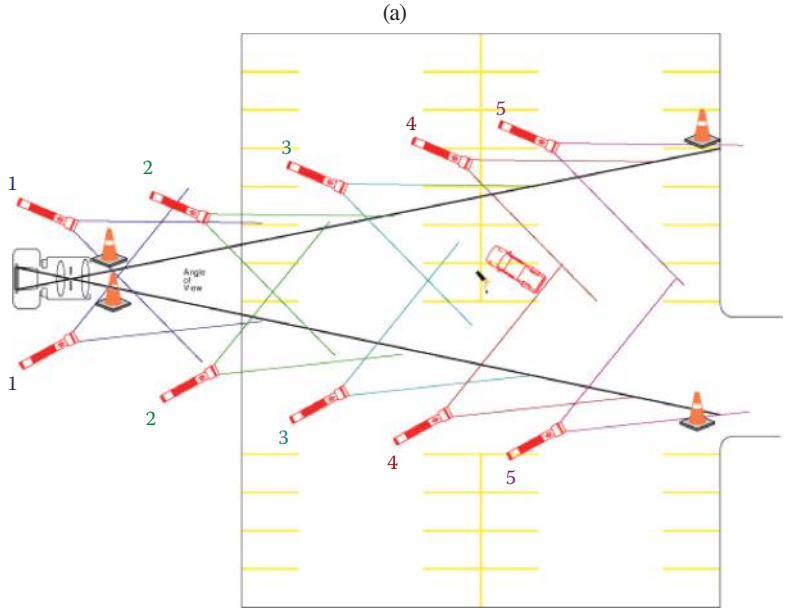
Painting with Light

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Manual Mode	**Shutter Speed:** Bulb	**Aperture:** f/4.0	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
Place the camera on a tripod. Attach the shutter-release cable to the camera. Adjust the aperture to f/11 and the shutter speed to bulb. Looking through the eyepiece, determine the outer limits of the camera's angle of view. This is done by going to the outer right and left edges of the scene. The person slowly walks toward the center of the scene. Once the person is in the angle of view, he or she should take a step backward and place a cone at that location. See Figure 4.25. This provides the person with the flash a boundary to remain behind.



(a)



(b)

FIGURE 4.25a,b Illustrates the proper light placements for Exercise 4.14: (a) illustrates using a single light; (b) illustrates using two lights.

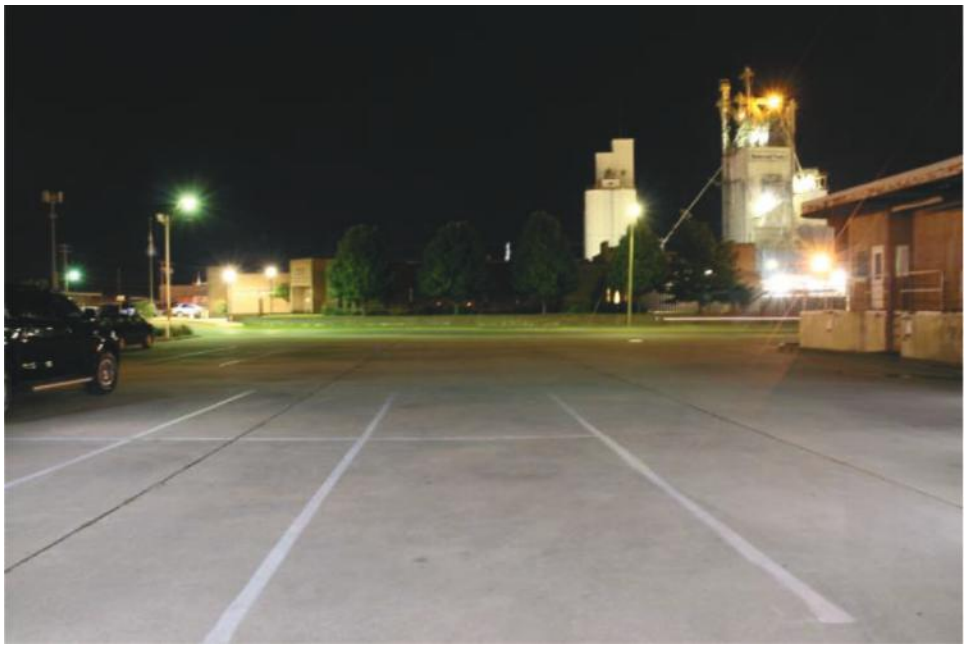


FIGURE 4.26 Photo of a large parking area illuminated using painting with light. Compare this to Figure 4.28.

Place a dark cover over the lens, such as a black fingerprint backing card. Do not use white or shiny metals, as they reflect light into the lens. Depress the shutter-release button on the shutter lock cable. The person with the flash is positioned a few feet from the camera with the flash head angled at a 45° angle toward the center of the scene. The flash person then counts to three. On two, the cover to the lens is pulled down. On three, the flash is manually fired. Once the flash is fired, the lens is covered with the same dark covering.

The flash person then moves farther away from the camera, keeping in mind to remain behind the cone boundary. This process is repeated until the area is properly illuminated. Release the shutter-release button. This exercise must be bracketed, adjusting one camera function (ISO, shutter speed, or aperture) one full stop. This exercise may also be repeated using multiple flashes to illuminate the scene.

FIGURE 4.27 Photo of the painting with lighting technique using a laser.

PHOTO EXERCISE 4.14B

Painting with Light: Laser

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Manual Mode	**Shutter Speed:** Bulb	**Aperture:** f/4.0	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
Place the camera on a tripod. Attach the shutter-release cable to the camera. Adjust the aperture to f/11 and the shutter speed to bulb.

Place a trajectory wall in the scene in front of the camera. Properly place a trajectory rod and laser in the trajectory wall. Turn the laser on. Use a large piece of white paper and position the paper so that the laser beam is shining on the paper close to the end of the laser. Practice walking away from the laser beam, keeping the laser on piece of paper.

Reposition the paper next to the tip of the laser. The person holding the paper begins to count to three. On two, the person begins to slowly walk away from the laser, in the laser beam's path. On three, the shutter-release button is depressed using the shutter-release cable.

Once the paper has gone out of the camera's angle of view, release the shutter-release cable. This exercise is then repeated using a flash. Once the paper has gone out of the camera's angle of view, manually depress the external flash unit into the area of the trajectory wall. This will provide additional illumination to the area while showing the laser painted in the photo.

PHOTO EXERCISE 4.15

Available Light

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Manual Mode	**Shutter Speed:** As Determined	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod.
2. Attach the shutter-release cable to the camera.
3. Adjust the camera to program-priority mode.
4. Depress the shutter-release button halfway to meter the lighting conditions of the scene.
5. Adjust the camera to manual mode and set the appropriate aperture and shutter speed.
6. Take the photograph.
7. Bracket the photographs by adjusting one camera function (ISO, shutter speed, or aperture).
   a. +1 stop
   b. +2 stops
   c. –1 stop
   d. –2 stops

FIGURE 4.28 Photo of a parking lot using the surrounding available light. Compare this to Figure 4.26.

5 Sketching Exercises

USES OF SKETCHES AND FORENSIC MAPS

Sketching is the third element to crime scene documentation (in addition to note taking and photography). In law enforcement responses, sketches are drawn for the following circumstances:

1. Vehicle crashes
2. Crime scene responses
3. Bomb blast or explosion responses
4. Disaster responses
5. Evacuations
6. Report writing
7. Planning required for security measures, organized raids, and public events

Theoretically, every scene should get a sketch, though this may not always be feasible. It should be left up to the discretion of the crime scene investigator as to whether or not a sketch should or should not be drawn. Realistically, sketches will be created for

1. All homicides
2. All officer-involved shootings
3. All suicides
4. All suspicious deaths

SKETCH INFORMATION

Simply drawing a sketch is meaningless or confusing unless additional details are included with the drawing. These include:

Header: The header should include:
1. Case number
2. Incident identification
3. Incident location
4. Date when the sketch was originally created, which may differ from the date of the crime if the sketch was created at a later date
5. Name of the person creating the sketch or forensic map

Legends: The legend may include:
1. Evidence legend
2. Blood legend
3. Furniture legend, etc.

Scales and orientation indicator: This area includes:
1. A north indicator
2. The dimensions of the scene
3. A "not to scale" notation (This should always be included in sketches because they are not architectural drawings. Including a scale transforms a sketch into a forensic map.)

REDUCING CLUTTER IN SKETCH

Consider creating multiple views of your sketch. Each view should be progressively smaller, showing more detail, or should concentrate on a specific aspect of the scene. It may include:

1. A view showing the overall scene
2. A view showing the furniture and its legend
3. A view showing the evidence and its legend
4. A view showing where the primary incident took place

Inevitably there will locations in the overall sketch that were not involved in the incident. These may have been included to give an overall perspective of the scene. It is these areas that create clutter and confusion and can be eliminated to create the scene where the primary incident occurred.

ADMISSIBILITY OF SKETCHES INTO COURT

The sketch may be admitted into court under the following criteria:

1. Must be a fair and accurate depiction of the scene.
2. Must be relevant or material to the point at issue.
3. Must not appeal to the emotions or prejudice the court or jury.
4. Must be supported by the verbal testimony of the person who made the sketch or someone who was present during the creation of the sketch, that is, *the sketch must be sponsored by someone*.

Note that there is no requirement for the sketch to be an architectural reproduction of the scene.

TYPES OF SKETCHES

Overview (floor plan, bird's-eye view) is a two-dimensional drawing of the scene. May include dimension lines. It will include the location of evidence. It can be hand drawn or computer generated.

Elevation sketch shows vertical plane rather than horizontal. It may be used to document walls to show bullet defects and blood spatter. It is good for burial sites to show layers removed and the location of evidence.

Exploded sketch is a combination of floor plan and elevation sketches, where walls are laid out flat. It is useful to show blood spatter relationships between two adjacent surfaces, such as the floor and the front of a stove.

Three-dimensional perspective is the hardest of the sketches to draw. It is designed to show two walls, the floor, and the ceiling and is good for documenting blood spatter.

MEASUREMENT

Accuracy of Measuring Devices

Not all devices are equally accurate. When choosing a measuring device, consider (a) the overall measuring range (it does no good to purchase a device that measures 2 ft to 300 ft when a majority of your measurements are nearer than 2 ft) and (b) the overall measuring accuracy (a steel tape with an error of ±1/8 in. is a better device than an electronic measuring device with an error of ±½ in.).

Typical measuring devices include:

Steel tape measure
Fiberglass or cloth tape
Roller tape
Laser measuring device
Electronic distance-measuring device (from total stations)
GPS (Global Positioning System) devices

Accuracy denotes the closest to the actual value. Precision denotes the repeatability of your measuring technique.

Use of Landmarks

Interior scenes: Use the same walls throughout the scene, if possible. If you use the north and east walls as reference to measure the living room, then use the north and east walls throughout the rest of the scene.

Exterior scenes: Telephone poles/boxes are very well documented. The center of the street is also very well documented, whereas curblines are not documented as well.

Fixed versus Nonfixed Measurements

Nonfixed measurements are generally measured to the center of the item and represent most measurements of evidence.

Fixed measurements are used when an item must be fixed within a scene, and two sets of measurements are necessary.

Significant figures: The measurements you report must correspond to the significant figures of the measuring device you use. Steel tapes are capable of measuring to two significant units, such as 34.75 ft or 34 ft 9 in.

Measuring Methods

Be mindful of how you measure items within the scene. Different measuring techniques will produce vastly different measuring distances.

Rectangular coordinates method utilizes fixed landmarks. Measurements are taken at 90° angles to the fixed landmarks.

Triangulation method uses two reference points. Measurements are taken at angles from these reference points to the object being measured. Do not use triangulated furniture or evidence to triangulate other items within the scene. Always use the original reference points.

Baseline method utilizes straight lines. Place a cloth or fiberglass tape in a straight line within your scene (the baseline). Preferably, place the tape measurer in a north-to-south or east-to-west orientation. Document one end of the tape measurer to a known landmark. Measurements are taken at perpendicular angles to the baseline tape measure.

Compass method utilizes a reference point where compass readings in degrees will be obtained. Document whether the compass is compensated for magnetic declination. Document whether the compass was corrected or uncorrected. Measure the distance from the reference point to the evidence or landmarks within the scene.

Magnetic declination: Most compasses read magnetic north. This is not true north. The difference between magnetic north and true north is magnetic declination. This value continues to change. Magnetic declination data is available from the National Oceanic and Atmospheric Administration (NOAA) for your area. If you have a compass that is correctable for magnetic declination, this information *must* be included in your report as well as what the correction was. If you use a compass that is not correctable or was not corrected, this information *must* also be included. In the event a sketch must be reconstructed years later, someone with compass skills will be able to take your information and properly reconstruct your sketch.

Polar coordinates method uses a laser and a horizontal angle (usually from a sighting device). Distances are measured from the instrument point.

Compass and polar coordinates: If you need more than one reference point, you can establish as many reference points as necessary. It may be necessary to use points between two reference points. These are referred to as *waypoints*.

Total station mapping utilizes surveying technology that combines automated transits, lasers, and computer technology. The total station mapping obtains three basic measurements:

1. Horizontal angle, which is set to magnetic north and is based on compass angles
2. Vertical angle
3. Slope distance

The software should be capable of generating a points list and a raw data file (or similar data tables), which are the "validation" of the map generated.

GPS method utilizes a triangulation from satellites. The GPS devices have a clock that measures the time it takes to triangulate your position. The accuracy of the device is therefore tied to the device clock. The downfall is that most all GPS devices advertise a very accurate service (less than a meter in most cases). However, when you download the legal information, one device may state that the data is accurate to 50 meters, while others may deviate by as much as a half mile.

Protractor method uses an actual protractor, which must be fixed within the scene.

CREATING A SKETCH

Supplies needed include:

1. Large sketch pad or graph paper
2. Pencil and erasers (The rough sketch should be done in pencil due to the need for editing and changing—a pen becomes messy very quickly.)
3. Measuring devices

Begin by drawing the overall layout of the scene. The rough sketch will not look exactly like the scene. Some walls may appear to be shorter or longer than they actually are. The measurements will correct this issue in the final sketch. Add doors and windows, including the door swing path. Add furniture and other nonevidence items. Add the body. Add the evidence. Once the general sketch has been created, measure the

1. Walls
2. Doors
3. Windows
4. Furniture and nonevidence items
5. Body, which includes the head, shoulders, elbows, wrists/hands, waist, knees, ankles/feet
6. Evidence

It may be useful to use the back side of the rough sketch to record measurements. The evidence is numbered on the actual rough sketch. Nonevidence may be alphabetically labeled on the actual rough sketch. The corresponding letter or number is placed on the back of the sketch. The measurement is placed next to the appropriate number or letter.

Sketching is a taxing and time-consuming task. One person can accomplish the task; two would make the job easier; and three would be ideal. The room/scene size ultimately dictates how many people can actually be involved in the sketching process.

The sketch can only include items in the scene as it was found by the individual creating the sketch. Remember, the sketch must be a true and accurate representation of the scene as *you* (the sketcher) found it. If the sketch is created days later and the scene is different from the original incident, your sketch *must* show the scene as *you* found it and not as it "looked" during the time of the incident.

Interval versus Continual Measuring Method

Whether you choose to use the continual method or the interval method, you should also measure the overall length and width of each room.

Interval measuring method: The scene is measured in small segments or intervals.

Continual measuring method: This method is similar to the baseline method. Each item/area being measured is measured back to a common reference point, such as the corner of a room.

Use of table or measurement log: The use of a preformatted log may be useful in recording pertinent measurements at the scene. (See Figure 5.1.)

Creating a Final Sketch

The rough sketch can be made final through ink drawings using pens and templates or computer applications such as Crime/Crash Zone, 3D Eyewitness, Microsoft Visio, etc.

Making Your Rough Sketch Permanent

Recall that the rough sketch may be seized by the court. This is not the seizing of a photocopy; the actual rough sketch may be seized. The rough sketch therefore must be made permanent. This can be done either by tracing rough sketch lines with an ink pen or using colored pencils to add additional security features.

Three-Dimensional Sketches

Three-dimensional (3-D) sketches may provide valuable information that the 2-D sketches simply fail to provide, such as shooting scenes and bloodstains. Close-up views may

need small descriptions to clarify points. These descriptions must be short so as not to detract from the overall intent of the 3-D sketch. These descriptions must be on a fixed plane and not rotated as the camera view rotates around the scene. If the 3-D sketch is admitted into court, one issue you must articulate is that the only thing changing in the 3-D view is the camera angle. If the descriptions are rotated with each camera view, then the camera angle is now not the only thing changing. If the descriptions are left on the single plane, at some point they will be upside down, inverted, or at some obscure angle. This helps indicate that the only thing moving in the 3-D sketch is the camera angle.

CONCLUSION

There are several ways to collect the sketching measurements. Some people place the measurements on the back of the graph paper, while others use specifically designed forms to log the measurements. Whichever process you choose, be consistent with the landmarks that you choose to measure from. This eliminates clerical issues in the event that you fail to document the landmarks for each and every measurement you take. By using the same landmarks throughout the scene, you minimize or even eliminate this issue. Figure 5.1 is an example of the use of a table to record your measurements.

Sketching Measurement Log

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date Processed:

Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
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Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						
Item #.	Description:	First Measurement:	Second Measurement:	Height of Object:	Height above Ground:	Other Measurements:
Notes:						

FIGURE 5.1 A form used to document measurements at a scene.

EXERCISES

During this exercise, you will complete a rough sketch of two areas. Each area requires a different measuring technique. The two measuring techniques cannot be the technique you use most often.

Equipment needed for the exercises includes:

Graph paper or drawing pad
Pencil
Measuring device

EXERCISE 5.1

Sketcher's Name:	Sketching Method:	Sketching Location:	Sketch Date:

EXERCISE 5.2

Sketcher's Name:	Sketching Method:	Sketching Location:	Sketch Date:

Section III

Locating Evidence

6 Searching

SEARCHES AND SEARCH PATTERNS

A *search* is defined as a systematic, methodical examination for any physical evidence at a crime scene. Crime scene investigators should be the only ones searching. When others also search, evidence is ultimately lost, damaged, or destroyed. This often results in a partially documented scene. You cannot document what you did while you document what the others are also doing. A crime scene investigator doing the search makes it easier to

1. Document and track the evidence
2. Protect the integrity of the evidence
3. Defend in court

There are six basic crime scene search patterns:

Circle or spiral search: This is an excellent pattern in most interior or confined exterior scenes. It is not effective in large exterior scenes or cluttered areas that impede the circular movement. The searcher moves either inward or outward from a starting point.

Lane or strip search: This search pattern is excellent in exterior scenes where a large area must be examined. Visual alignment to the lane or strip is good for most situations. As the search area grows, it becomes more difficult to maintain a visual reference of the lanes. Physically laying out the lanes or strips with string or tape can help maintain the order.

Grid search: This is a variation on the strip search. The searcher follows strips in one direction, then cuts across the original search area in another set of strips, oriented 90° to the first. This pattern allows the searcher to examine one area twice from different perspectives.

Line search: Multiple searchers follow a single strip in one direction and remain in line with each other. This is an excellent search pattern for exterior scenes over rough terrain. It usually requires supervisor(s) to maintain the direction and alignment of the searchers.

Zone search: A large search area is broken down into more manageable zones. Each separate zone may be searched with any of the other searching patterns. The zone search is used in several variations:

1. To deal with small confined spaces where no patterned search will work
2. To break a larger scene down into more-functional search areas that are then searched using some other search pattern

Point-to-point search: Not widely used in the United States. Searchers move from one focal point to the next, creating cleared pathways to and from each point. When walking through the scene, searchers do not stray from these pathways. Each focal point is dealt with before moving on to the next.

INTRUSIVENESS OF THE SEARCH

Searches must progress from least intrusive to most intrusive. Any other progression will result in evidence being overlooked, damaged, or destroyed. This progression is done to minimize the effects of Locard's Principle. The least-intrusive search possible is a visual examination of the area. This may progress from a visual search to

1. Moving furniture to continue the search
2. Collecting DNA and trace evidence
3. Processing for latent fingerprints
4. Processing using chemical enhancements
5. Cutting holes in furniture and walls
6. Taking carpet/other cutting samples for evidence

SPECIAL CONSIDERATIONS

There are situations that we must take into account when planning a search. Some of these include:

The light width: The width of your flashlight may not seem to be very important. However, when you are searching for evidence at night or in low-light situations, it becomes very important. The width of your flashlight determines how wide your search pattern will be.

The search terrain: This also plays an important role in which search pattern will actually be used. Each surface may pose additional obstacles that must be dealt with.

Searching priorities: Obviously, our initially priority must be on the ground. This is where evidence will fall. There may be footwear/tire impressions as well. There also may be indications that furniture has recently been moved. Bloodstains or other discolorations may be seen. The next area of priority is the ceiling. This is another area where evidence may eventually end up. Suicides with shotguns are very destructive and result in large amounts of blood and body tissue deposited on walls and ceilings. Failing to see this may result in the blood and/or body tissue falling onto you as you walk into the room. The third search priority covers the walls and what is at

eye level. During the searching of what we are about to step on and what may fall on us, we sometimes forget to look at the obvious areas.

Weather conditions: This may force us to abandon the original processing methodology and simply pick up the item and place a marker next to where it was. Ideally, we would like to have a photograph of the evidence in its original unaltered condition next to the marker, but due to the weather, we may be unable to do so. By leaving the evidence as it is, we risk losing valuable trace and DNA evidence. The amended procedure would include:

1. Placing an evidence marker or cone where the evidence is
2. Collecting the evidence and properly packaging and securing it
3. Photographing and measuring the marker
4. Documenting in the notes and reporting the reason for deviating from standard procedures.

INTERIOR AND EXTERIOR SEARCHES

Interior Searches

Divide each room into smaller, more-manageable zones. Room size may be divided as follows:

1. Divide in half zones
2. Divide in quarter zones
3. Divide into more zones depending on room size, etc.

Divide the walls also into zones:

1. Bottom 1/3
2. Middle 1/3
3. Top 1/3, etc.

Determine Which Search Pattern to Use

You search one zone while your partner searches another zone. Each time evidence is found, start the search over. Search until a complete search of the zone reveals no further evidence. Switch with your partner and search his zone. Search in the same manner until no further evidence has been located. Once these areas have thoroughly been searched, move onto the next zone and repeat the process until all areas have been thoroughly searched. As humans, we must recognize that we are not perfect. Taking a defensive approach—by feeling offended when someone else searches your area and not allowing any one else in to search the area—is inappropriate. Doing so may potentially lead to evidence not being identified and collected. Search in areas you least expect. People will hide things in every imaginable place. If something looks odd to you, then it probably needs further investigation. When evidence has been located in a particular zone, document it with notes, photographs, and sketches. Communication is also necessary. It lets other investigators know what you found and where you found it.

Exterior Searches

The same philosophy for interior searches applies to exterior searches. The main difference is, if possible, put off doing night searches until daylight. The external lighting never seems to be enough light when compared to the sun or daylight. If you must search at night, make arrangements to return (or for other investigators to return) during the day to conduct another search. Inevitably, when processing a scene, your attention may be directed in other areas away from the current task at hand. You have two options:

1. Complete the task at hand and then process the other area
2. Suspend the current task and process the other area before returning to the previous task.

No matter which route you take, if some form of note taking is not done, you will inevitably forget something: forget to do the additional requested task; forget where you left off from the previous task. This can be mitigated by making a to-do list or simply making a notation in your field notes. Either way, do not forget to periodically review these notes to make sure that each request has been handled.

Extremely large or complex scenes may require the use of physical markers (such as strings) to define search zones or lanes. Consider placing a notepad at each zone (Figure 6.1). This allows the searchers to document who and when someone searched an area. It also provides a way to document what was found in that area. During the end of the scene processing, these small notes can be collected and used to determine whether additional zones need to be searched prior to releasing the scene.

Searching an Area by Yourself

This is the least desirable situation simply because only one set of eyes will be examining the scene. The same principles for interior and exterior searches still apply; however, you will be the only person conducting the searches. Draw a sketch of the area to be searched. Check off each zone when the search is completed. Search each zone multiple times until no additional evidence is located.

Vehicle Searches

The best searching practice involving vehicles is to move the vehicle to an indoor processing facility, preferably a climate-controlled facility. If the decision is made to move the vehicle to an indoor processing facility, the ground around the vehicle must be processed prior to removing the vehicle. The exterior of the vehicle may need to be processed prior to transport to collect any valuable trace evidence that may be lost during transport. Do not simply assume that the evidence will remain on the vehicle during transport. Consider the potential effects of rain, high winds, etc.

If there will be some time between the placement of the vehicle in the processing facility and the time it will be processed, the vehicle should be sealed with evidence tape. Consent for search or a warrant may need to be obtained. The

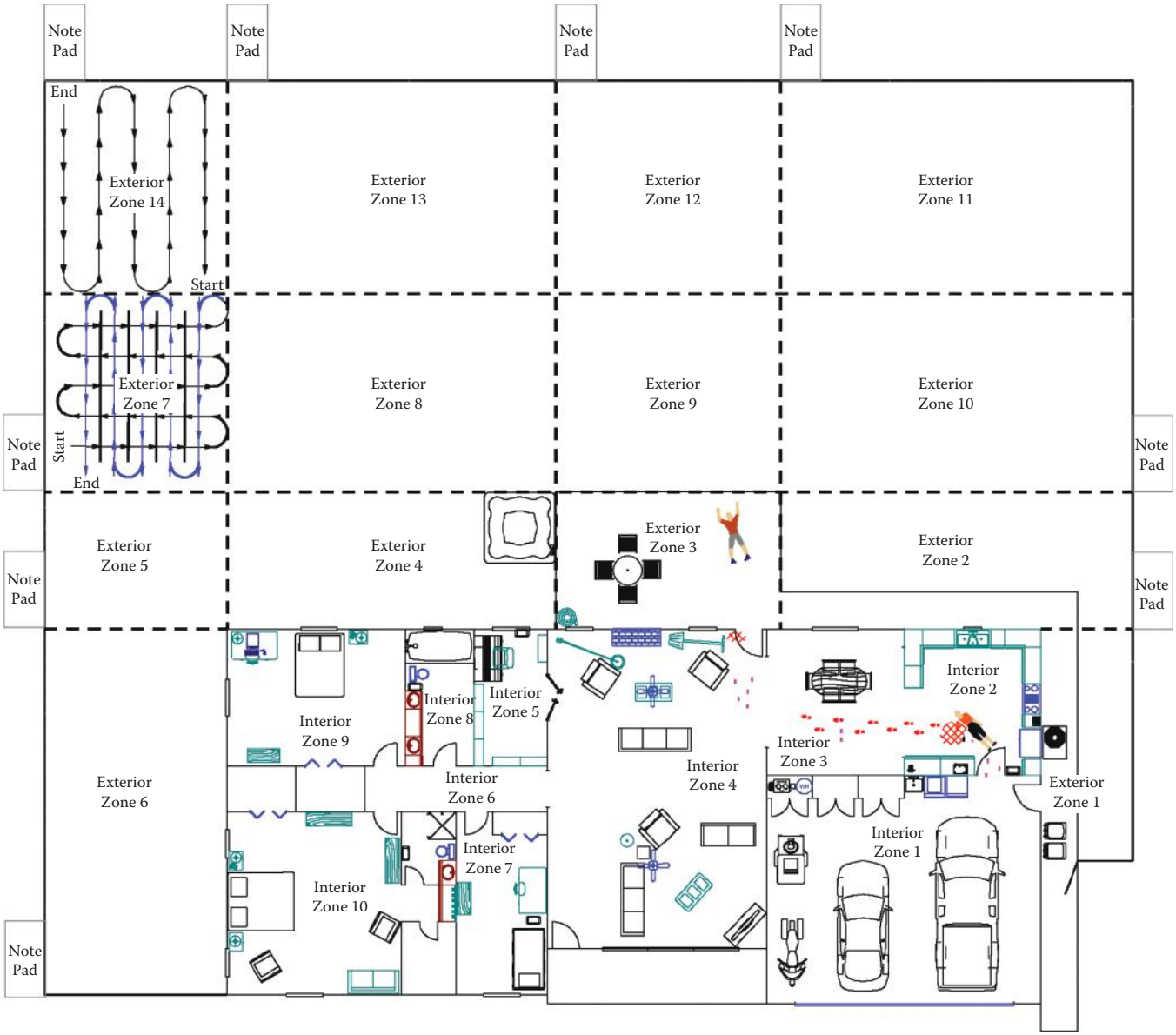


FIGURE 6.1 Illustration of using notepads for each zone to allow searchers to document who searched the zone and what method the searcher used in the zone.

evidence seals should be placed low on the door so that they do not interfere with the fingerprint processing. Evidence seals should also be placed near the center of the trunk and hood, where they will not interfere with fingerprint processing.

Towing Vehicles

The courts have ruled that as long as an officer has constant visual contact of the towed vehicle, the vehicle remains in the officer's custody, even though it is being towed. Once the vehicle leaves the officer's visual area, the tow driver is placed in the chain of custody.

Exterior Vehicle Searches

Search for any trace evidence. Process the exterior for prints. For a hit-and-run vehicle, consider placing it on a lift to search the undercarriage.

Interior Vehicle Searches

Divide interior into zones:

1. Driver front
2. Passenger front
3. Driver rear
4. Passenger rear
5. Trunk
6. Underneath the hood

Search for trace/biological evidence. Areas should then be processed for latent fingerprints. Search areas

1. Underneath and beside seats
2. Door panels
3. Dashboards, to include vents, stereos, seams between top of dash and front of dash, and air-bag areas
4. Trunk
5. Engine compartment

EXERCISES

Exercise 6.1

The student will conduct several searches on multiple types of surfaces:

Concrete
Grass
Asphalt
High grass

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date Processed:

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

Exercise 6.2

The students will perform the following search patterns on each surface:

Strip or lane search
Grid search
Spiral search

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date Processed:

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

Exercise 6.3

A large area will be searched by the class using the zone search. Identify the specific search pattern that was searched in each zone.

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date Processed:

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

7 Alternate Light Sources

THE ELECTROMAGNETIC SPECTRUM

The electromagnetic spectrum is the range of all magnetic radiation. As one moves from left to right across the spectrum:

1. Frequency decreases
2. Energy decreases
3. Wavelength increases

Interestingly, visible light—what we can actually see—makes up a very small portion (400–700 nm) of the electromagnetic spectrum.

When light strikes a surface, the color of the object is a result of the particular light waves reflected back from the surface. All other light is absorbed by the object. This is how we see color in objects. White light contains equal quantities of all light in the visible spectrum, so white objects reflect all light, while black objects absorb all light. Examples of white light are light originating from the sun and LED (light-emitting diodes) lights.

White light consists of equal concentrations of all the light in the visible spectrum. Yellow light has unequal concentrations of the light in the visible spectrum. This unequal concentration of light affects the absorption and reflection phenomena necessary to see objects.

QUALITIES OF LIGHT

Light is ultimately electromagnetic radiation. The use of the alternate light source (ALS) is examined through the physical interaction between the light and the surface being examined. Various forms and qualities of light are outlined here.

Transmitted light is light that completely passes through a surface. Light that strikes a surface at 90° angle is referred to as a simple transmission. This is not visible light and, therefore, cannot be photographed. It is also commonly referred to as transparent.

Refracted light is the light that passes through a surface at other than a 90° angle. As light passes through the surface, the light is separated according to its wavelength. Shorter wavelengths travel faster than longer wavelengths.

Diffracted light is the bending of light. This occurs in photography when using very small apertures, such as smaller than f/22.

Absorbed light is light that is neither reflected nor transmitted. Black objects absorb all light and reflect no light, while white objects absorb no light and reflect all light.

Reflected light is neither transmitted nor absorbed.

Absorption and *reflection* of light are the fundamental bases for ALS techniques. Using a single wavelength of light rather than the entire visible spectrum of light allows us to visualize evidence that otherwise might go unnoticed.

ALTERNATE LIGHT SOURCES

Photoluminescence is the general term used to describe the process of an atom absorbing energy, with the electrons excited to a higher energy state. As the electrons return to a lower energy state, a photon of energy is released.

Fluorescence is generally an optical phenomenon in cold bodies. Molecular absorption of a photon triggers the emission of a photon with a longer wavelength. In this phenomenon, the use of light as the energy source causes the object to glow. Once the light source is removed, the object no longer glows.

Phosphorescence applies to materials that do not immediately reemit the radiation they absorb. The absorbed radiation may be reemitted at a lower intensity, at times for up to several hours. This is the phenomenon behind glow-in-the-dark materials.

Chemiluminescence is the emission of light as a result of a chemical reaction. Luminol is a common example of this type of phenomenon.

Luminescence describes the emission of light, usually at low temperatures. This is often called cold-body radiation, typically seen in watch dials and aviation navigation instruments. This is different from the phenomenon of incandescence, which occurs at high temperatures, such as in lightbulbs.

Fluorescence occurs as electrons return to their original state, giving off energy as light. Some energy is converted to heat, while other energy is emitted in the form of photons. The photon energy is less than the original energy.

FILTERS

Two categories of filters include visualization filters and forensic filters.

Visualization filters: Visualization filters are color-correction filters, generally of primary colors such as red, blue, and green. They are used to increase the contrast between the subject of a photograph and the background.

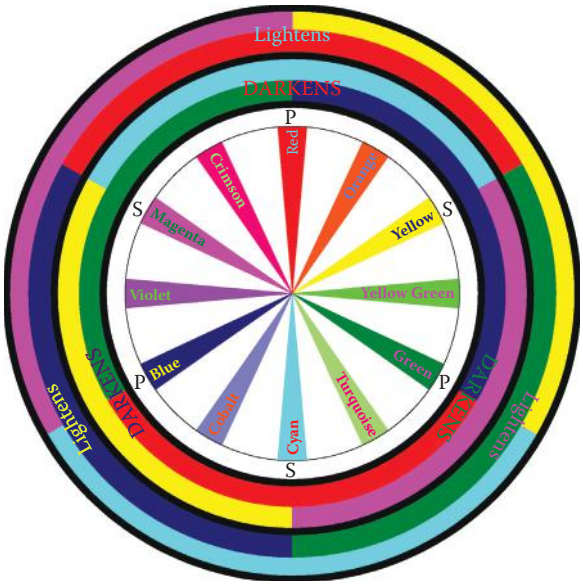


FIGURE 7.1 Color wheel.

Color wheel: Without color, the world would be many shades of gray. Colors interact with each other, which is the basis of the color wheel. Color addition occurs by combining two primary colors, thereby producing a secondary color. The primary colors are red, green, and blue. Secondary colors include cyan, yellow, and magenta. Red + green produces yellow, while red + blue produce magenta, and green + blue produces cyan. Primary colors are additive. Color subtraction describes how we see things that are not capable of producing energy. For example, grass is green because it contains pigments that absorb or subtract the wavelength of light that will not be reflected, in this case all colors except green. Opposite colors interact by taking advantage of how they interact with each other. Consequently, we may be able to use a light-source wavelength to change the background by darkening it, thereby making the actual subject of the image more visible. A cyan filter will darken reds, yellows, and magentas and will lighten blues and greens.

Forensic filters: Forensic filters are used to see what normally would not be possible to see with the naked eye. They do not add anything to the scene. They simply allow us to see what is already there. These are generally the yellow and orange filters.

Photoluminescence in crime scenes: There are many situations where a crime scene investigator may observe a photoluminescence phenomenon. This "glowing phenomenon" is a model of light particles in action. Semen and fluorescein are two examples of photoluminescence. The type of photoluminescence we actually observe is fluorescence rather than phosphorescence. Long-pass filters transmit longer wavelengths and block shorter wavelengths. Short-pass filters transmit shorter wavelengths and block longer wavelengths. Band-pass filters take advantage of the long-pass and short-pass filters. These filters are made up of multiple layers that block transmission of everything outside the selected wavelength range. Bandwidth is the range of wavelengths allowed to be transmitted through a specific filter.

Camera Filter versus External Light Filter

These filters are produced differently. Some cameras are manufactured with internal filter functions.

Camera filters are designed to absorb small amounts of energy.

External light filters are designed to absorb large amounts of energy, and they can become very hot.

A camera filter placed in front of a light source will not be able to absorb the energy and will ultimately crack. When the performance is compared, the external filters perform better than the internal camera filters.

Photo Exercise 4.16

Alternate Light Source—RGB Filters

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Program Mode	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod.
2. Locate several objects of multiple colors that contrast with the background.
3. Use the RGB (Red Green Blue) filters to lighten or darken the background.
4. Use the color wheel to assist in determining which filter to use.
5. Take the photograph.
6. Switch to monochrome mode and repeat the photograph you just took.
7. Compare the color photos to the monochrome photos.

Notes: _____

8 Presumptive Tests and Chemical Enhancements

PRESUMPTIVE TESTS

A presumptive test will provide one of two results:

1. The sample is *definitely not* a certain substance.
2. The sample *probably* is the substance.

Presumptive tests are used to locate suspected bloodstains and/or semen stains. These tests are a method to eliminate nonevidence stains from evidence stains. Figure 8.1 shows images illustrating the collection of a sample and then performing the presumptive test on the collected sample and not on the stain itself.

Catalytic Tests

The heme group of the hemoglobin possesses a peroxidase-like activity. It is able to split hydrogen peroxide (H_2O_2) into two hydroxyl groups (OH^-). The oxidizing species formed in this reaction can then react with a variety of substrates to produce a visible color change.

Specificity versus Sensitivity

Sensitivity describes some tests that are capable of reacting when there is a very dilute chemical. Specificity refers to tests that react with a specific substance.

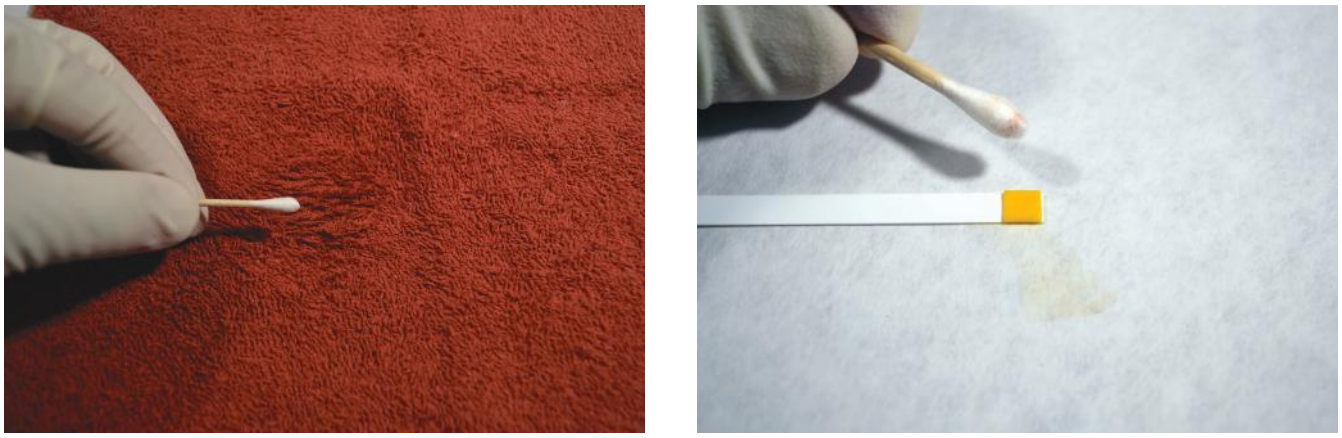
Swab Testing Method

A swab is dampened with a drop of distilled water. A sample of the suspected stain is then collected with the swab by rubbing a small area with the damp swab. The particular test is then performed on the sample on the swab rather than the suspected stain itself.

Pouch Testing Method

A drop of distilled water is placed on a sterile swab. A sample of the suspected bloodstain is then collected with the wet swab. Remove the plastic clip on the pouch and open the pouch (Figure 8.2a). Place the swab containing the suspected blood in the center harness (Figure 8.2b) and break off the swab (Figure 8.2c). It may be easier to hold the center harness while breaking off the head of the swab.

Close the pouch and replace the plastic clip (Figure 8.2d). Break the left ampule by grasping the center of the left harness and squeezing the center of the harness (Figure 8.2e). Agitate the pouch. Break the right ampule by grasping the center of the harness and squeezing the center of the harness (Figure 8.2f). Agitate the pouch. A blue-green color within a few seconds is indicative of a positive test.



(a) (b)

FIGURE 8.1 Illustrates the use of testing a suspected blood stain using Hemastix: (a) utilizes a swab to collect a test sample. (b) The test samples collected from the swab is then tested on the Hemastix test strip.

FIGURE 8.2 Illustrates performing a presumptive test using a pouch, (a) opens the pouch, (b) inserts the swab into the pouch, (c) breaks off the stem of the swab so the pouch can be closed, (d) closes the pouch, (e) breaks the left ampule, and (f) breaks the right ampule.

Types of Presumptive Tests

Hemastix: This test is used in the medical field to test for blood in urine. Hemastix should not be used past the expiration date, as the effectiveness of the chemicals in the test strips becomes diminished. The chemicals in this test inhibit DNA analysis. Collect a sample using a swab, filter paper, or cotton swatch. Touch the tip of the swab on the yellow test strip area. Any reaction over 1 min is considered an invalid test and, therefore, a negative test. Do not touch the test strip or swab (after touching the test strip) on another stain.

Phenolphthalein (Kastle-Meyer): This test was first developed in 1903 and is actually a pH indicator. There are kits commercially available. The kits are

provided with instructions. Follow the instructions provided. A positive reaction is a pink color.

Leucocrystal violet (LCV): This is a catalytic test for blood. LCV is a reduced form of crystal violet. A positive test is shown by a bright blue color.

Tetramethylbenzidine (TMB): This is the primary reagent in Hemastix. A positive reaction is shown by a green color.

O-tolidine: This test was the original primary reagent in Hemastix until it was replaced by TMB in 1992. A positive reaction is indicated by a deep blue color.

Hemident/McPhail's Reagent/leucomalachite green (LMG): This is an oxidation-reduction reaction. The LMG is the reduced form of malachite green. LMG reagent is oxidized. The hemoglobin catalyzes the reaction between the LMG and hydrogen peroxide. The available hydrogen atom in LMG is donated to the hydroxyl groups, oxidizing the reagent into its color form of malachite green.

EXERCISES

EXERCISE 8.1

The use of presumptive tests will be performed on bloodstains to provide a visual identification of a positive reaction. After the reaction is performed, write a brief description of the positive reaction.

Hemastix

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Phenolphthalein

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Leucocrystal Violet (LCV)

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Tetramethylbenzidine (TMB)

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

O-Tolidine

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Additional Method:

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Additional Method:

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

PHOTO EXERCISE 4.17A

Presumptive Tests

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
During the exercises where the students will be utilizing various presumptive tests on known samples of blood.

1. The student will photograph the positive reactions observed for each test.
2. The students will also photograph any negative reactions observed.

Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative
Presumptive Test:		☐ Positive	☐ Negative

CHEMICAL ENHANCEMENTS

Chemical enhancements are used to further enhance bloodstains. Chemical enhancements may be used when

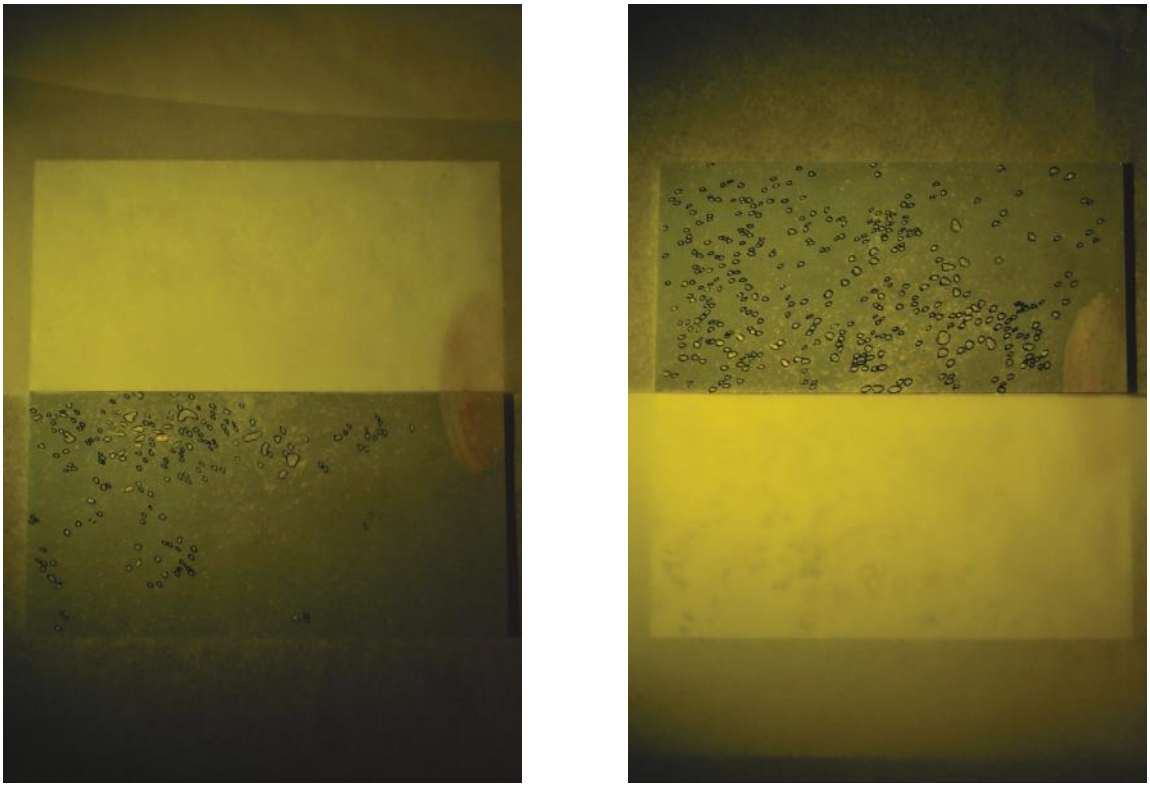
1. Blood scenes appear to have been cleaned up
2. Attempting to locate the actual scene
3. Attempting further enhancement of visible impressions (*Do not use on visible blood*, other than to enhance impressions.)

Many of the chemical enhancements are single-step processes, with the exception of fluorescein. By using a multistep approach with fluorescein, you may efficiently eliminate stains and/or reactions that are not blood and concentrate on stains that are blood. During the examination of the surface, using a black, blue, and red marker, you are able to document each step photographically. The three color markers are still distinguishable from one another when using an orange filter.

Figures 8.3–8.5 present images of fluorescein (Figures 8.3a, 8.4a, and 8.5a) and Hemascein® (Figures 8.3b, 8.4b, and 8.5b). Begin by examining the surface using a blue light (415–475 nm range) and an orange filter. This initial examination is to identify anything that is on the surface that fluoresces. If you observe anything during this examination, circle the fluorescent area with the black marker. Figure 8.3 shows images of the initial examination of the surface. The black marker was used to circle the areas that fluoresced prior to the application of any chemicals.

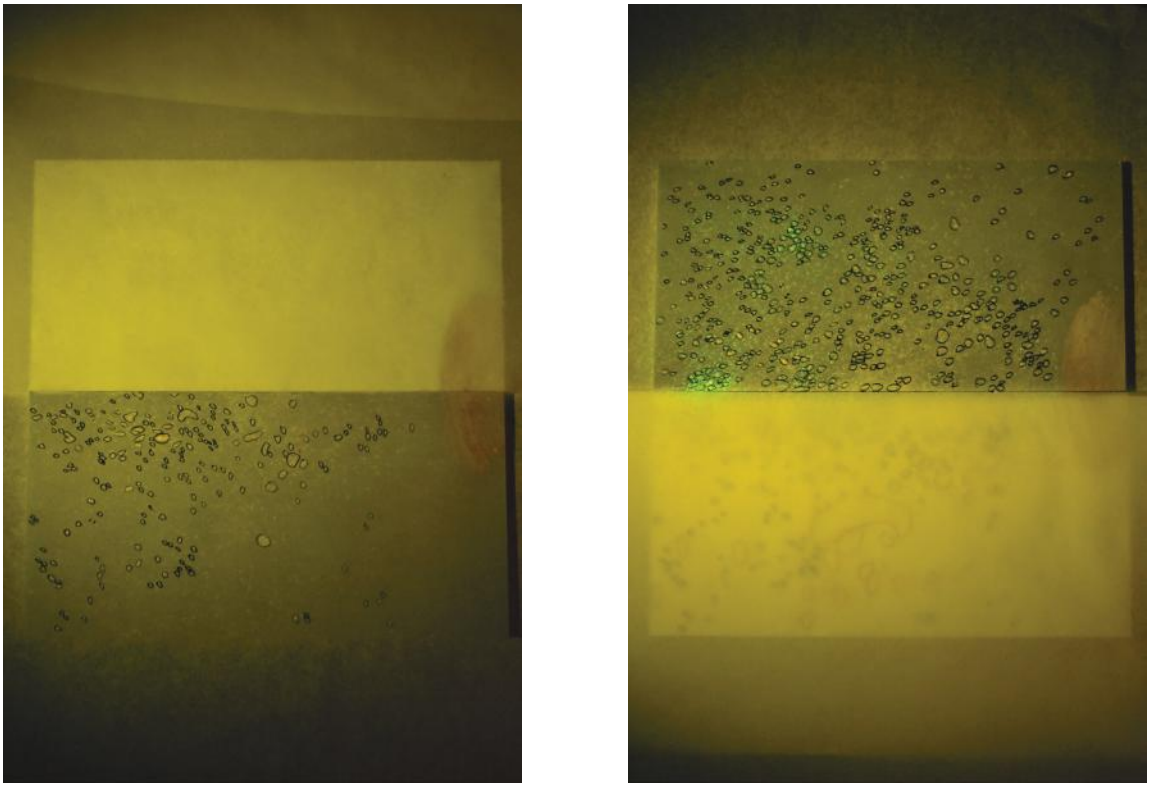
Once the initial examination has been completed, apply the fluorescein or Hemascein solution. The surface does not need to be saturated; a simple coating with a fine mist will be sufficient. Allow the surface to completely dry prior to continuing. The use of a hairdryer may be useful at this stage. If a hairdryer is used, ensure that only cool air is used, as the heat may destroy the DNA in the blood. Some hairdryer models have a button that may be depressed for cool air. Use this button. Do not use a hairdryer that does not have a setting or button for cool air.

Once the surface has dried, reexamine the surface using the same blue light and orange filter. This examination is to identify those areas that reacted with the fluorescein or Hemascein solutions. If anything fluoresces, use the blue marker and circle these areas. Figure 8.4 shows images of the second step of the fluorescein or Hemascein process. Notice these areas in Figure 8.4b (the Hemascein process),



(a) (b)

FIGURE 8.3 These photos demonstrate the first step in the (a) fluorescein and (b) Hemascein processes. Fluorescing areas are circled with a black marker.



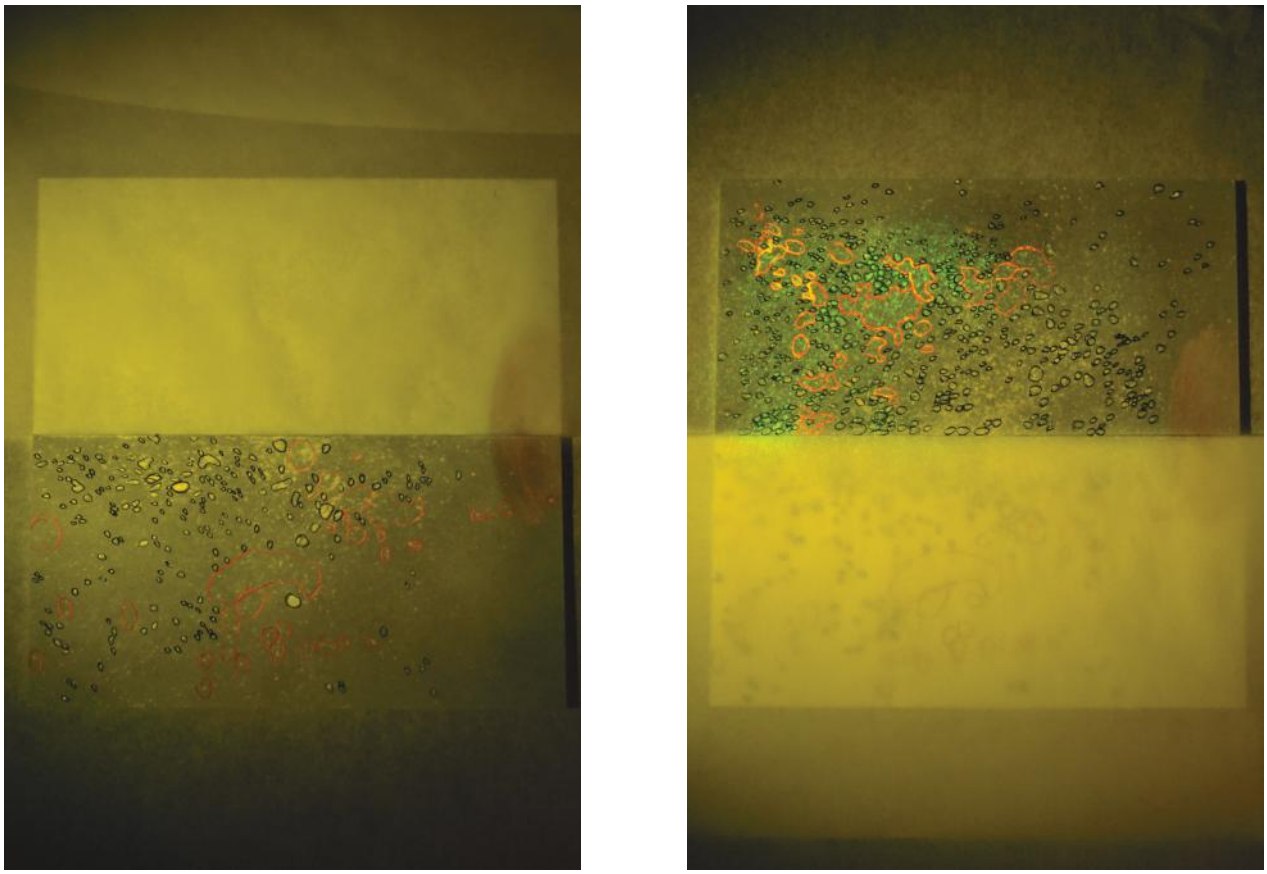
(a) (b)

FIGURE 8.4 These photos demonstrate the second step in the (a) fluorescein and (b) Hemascein processes. Fluorescing areas are circled with a blue marker. Note: these photos also show Step 1.

where the areas that reacted with the Hemascein chemical actually fluoresce more brightly than the areas from the first step.

Following the completion of the second step, apply the hydrogen peroxide overspray. The same process used to apply the fluorescein or Hemascein chemicals are used to apply the overspray. Allow the surface to dry. During the application of the overspray, this author uses the blue light and orange filter to examine the surface as the overspray is being applied. Often, you will see an immediate reaction when the overspray is applied. When I photograph the surface prior to allowing the surface to completely dry, I find that the fluorescence is much less than if I were to simply wait for the surface to dry. The use of a hairdryer may be used, but on the cool-air setting only.

Once the surface has dried, using the same blue light and orange filter, reexamine the area a third time. Anything that fluoresces should be circled with the red marker. These are the stains that we want to collect. Figure 8.5 shows images of the final step of the fluorescein or Hemascein process.



(a) (b)

FIGURE 8.5 These photos demonstrate the final step in the (a) fluorescein and (b) Hemascein processes. Fluorescing areas are circled with a red marker. Note: these photos also show Step 1 (Figure 8.3) and Step 2 (Figure 8.4).

EXERCISE 8.2

The use of chemical enhancements will be performed on bloodstains to provide a visual identification of a positive reaction. After the reaction is performed, write a brief description of the positive reaction.

LCV

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Fuchsin Acid

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Fluorescein

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

1. Examine the area using blue light and orange filter. If anything fluoresces, circle with black marker.
2. Apply the fluorescein.
3. Reexamine the area using the same blue light and orange filter. If anything fluoresces, circle with a blue marker.
4. Apply the hydrogen peroxide overspray.
5. Reexamine the area with the same blue light and orange filter. If anything fluoresces, circle with a red marker.
6. Photograph each step.

BlueStar

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

PHOTO EXERCISE 4.17B

Chemical Enhancements

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
During the exercises where the students will be utilizing various chemical enhancements on known samples of blood.

1. The student will photograph the positive reactions observed for each test.
2. The student will also photograph any negative reactions observed.

Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	
Chemical Enhancement:	

Discussion:
Describe the difference between the different chemical enhancement techniques used.

EXERCISE 8.3

The use of cleaning products to clean a bloody crime scene is an issue you must consider, especially if there are numerous injuries on the victim and the scene seems to be free of any visible bloodstains. Some of these cleaning products fluoresce. Place several cleaning products on various surfaces.

Use full strength, half strength, and quarter strength of each cleaning product. Allow the surface to dry. Examine each surface using various wavelengths of an alternate light source and different color filters. Describe the characteristics observed for each cleaning product. Note the wavelength and color of the filter that allows you to best observe the fluorescent effects of the cleaning products.

Cleaning Product:		

Cleaning Product:		

Cleaning Product:		

Cleaning Product:		

Cleaning Product:		

PHOTO EXERCISE 4.17C

Cleaning Products

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:
During the exercises, the students will be utilizing various cleaning products,

1. Place several cleaning products on various surfaces (use full strength, half strength, and quarter strength) and allow the products to completely dry.
2. Photograph each fluorescent stain using the appropriate wavelength and filter color.

Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	
Cleaning Product:	

Discussion:
Describe the differences between the various cleaning products used.

CONFIRMATORY TESTS FOR BLOOD

Crystal tests are confirmatory tests for blood. These include:

1. Takayama test or hemochromogen test
2. Teichman test
3. ABAcard

Confirmatory tests are generally sensitive to 1:10 dilution. Presumptive tests are sensitive to 1:1000 dilution, and some are sensitive to 1:100,000 dilution. It is possible to have a presumptively positive test and confirmatory negative test due to the dilution.

SEMEN

Semen is a body fluid that is left in fewer than 50% of all rape cases. There are various ways to test for its presence.

- An acid phosphate test uses a filter paper to collect the stain. The test is performed on the filter paper. A positive reaction is a purple color.
- Semen stains collected may also be examined using a microscope.
- P30 is a protein found in seminal fluid. Using an ABAcard P30, a positive reaction is denoted by a pink line.
- TMP presumptive semen test is a test for the presence of acid phosphatase. A positive reaction is denoted by a bright blue color.

Semen stains may be photographed using a 414–465 nm blue light and an orange filter.

A NOTE ON SHELF LIFE

When a product or chemical formula provides a shelf life, it is meant as a guideline. Over time, the active reagents become less effective. Eventually the active reagents will fail to perform as directed. Any chemicals used on actual evidence should be within the prescribed shelf life. Expired chemicals should be used for training purposes only.

9 Latent Fingerprint Development Exercises

INTRODUCTION

Collection of fingerprint evidence involves the use of techniques that require repetitive practice to improve your fingerprint-lifting skills. Without continued practice of your fingerprinting skills after your initial training, your skills will become stagnant. If you were requested to process a beer bottle for latent fingerprints and you were provided with information that the bottle was taken in a burglary, you would probably have little problem processing the bottle. However, if you were then provided additional information that someone was shot and killed during the burglary and that this bottle was handled by the suspect, your stress level would go through the roof.

What is the difference between the beer bottles in the two cases, other than the type of the crime? There is no difference between the two bottles except for the stress level you are under while processing the second bottle. Practice your fingerprinting techniques and you will be comfortable and confident with your skills, no matter what the circumstance.

ABOUT FINGERPRINTS

Fingerprints are developed during the 10.5th–16th weeks of gestation, with the patterns on the finger pads determined by the 19th week. The actual ridges are formed in the dermis layer of the skin. The fingerprints remain unchanged throughout an individual's lifetime. However, as the individual ages from birth to adulthood, the only change in the fingerprint patterns is the size of the pattern. As the child grows, so does the size of the individual fingerprint pattern; the pattern itself does not change. There are some factors that affect the quality of the fingerprints: Cuts and scars oftentimes only affect a small area of the fingertip ridges. Bricklayers and others who work with abrasive materials may lose the friction ridges on their hands entirely, although the ridges will eventually reemerge when the hands are no longer subjected to abrasion.

Fingerprint Characteristics

Fingerprint characteristics are the distinctive details of the friction ridges. These characteristics make up three main patterns—arches, whorls, and loops. Each pattern has several subcategories, such as plain arches, tented arches, plain whorls, double-loop whorls, central-pocket whorls, accidental whorls, ulnar loops, and radial loops.

Fingerprint Classification Statistics

Of the three main fingerprint patterns, 65% of all fingerprints are loops, 30% are whorls, and 5% are arches. Of the arches, 93% are ulnar loops; 85% of the radial loops are on the index fingers; and 20% of all index fingers are radial loops. Of all the arches, 54% are tented arches on the index finger and 28% are tented arches on the middle fingers. Of the whorls, 60% of all double loops are on the thumb, 45% of all central pocket loop whorls are on the ring finger, and 70% of all accidental whorls are on the index fingers. The average rolled print may contain as many as 125 details.

A Point of Clarification

A latent fingerprint is basically what is left behind when a person touches an item. A latent fingerprint may be the entire friction ridge or a partial of the friction ridge. In either case, the latent fingerprint is a whole latent fingerprint, even though a latent fingerprint may only be a partial of the entire friction ridge. Using such terms as a partial latent fingerprint implies that only part of the latent fingerprint was lifted and submitted for analysis, which is incorrect. Therefore, the latent fingerprint submitted for analysis is a whole latent fingerprint, or simply a latent fingerprint.

USES OF FINGERPRINTS

Fingerprints are useful in many ways. For example, proving the presence of someone at a crime scene is very useful in criminal investigations. Fingerprints may also be useful in proving someone's innocence, and fingerprints can help in identifying the deceased.

What a latent fingerprint will not tell you is when the latent fingerprint was left on the surface. It will not tell you whether or not the person leaving the latent fingerprint committed the crime. A latent fingerprint simply places the person in contact with the item that was touched. Well, if this is in fact the case, why even bother with processing items of evidence for latent fingerprints? Such evidence is gathered because there are occasions where suspects make statements denying their involvement in a particular incident or ever being in a particular location, etc.

THINGS TO CONSIDER BEFORE FINGERPRINTING

There are several things to consider before fingerprinting, including

1. The age of the latent fingerprint
2. Pre-puberty considerations
3. Skill level of the crime scene investigator

4. Additional factors such as the type of surface, the presence of contaminants, the monetary or sentimental value of the items to be fingerprinted, and the portability of the evidence

For example, pre-puberty children do not produce oils. Placing a vehicle in a non-climate-controlled processing facility during the hot summer months may result in the complete evaporation of the latent fingerprints left by a child. In this case, consider processing the vehicle as soon as possible due to the exigent circumstances.

FINGERPRINT DEFINITIONS

A fingerprint is an impression of the friction ridges of all or any part of the finger. Friction ridge detail (morphology) is an area that comprises the combination of ridge flow, ridge characteristics, and ridge structure. Fingerprints are the most positive means of identifying individuals, as fingerprints are permanent.

THREE CATEGORIES OF FINGERPRINTS

Latent fingerprint: Invisible or not obviously visible to the naked eye and requires additional processing to be visible

Patent or visible fingerprint: Requires no additional processing to be visible

Plastic fingerprint: Occurs when the surface touched is soft and conforms to the ridge pattern

EXPERIMENTING AT THE SCENE

Before processing items for latent prints, you may want to find the same item or a similar item and try different techniques to see which would work best. Once a suitable technique has been found, process the evidence. If prints are developed, return to your test item and determine the best lifting process.

TYPES OF BRUSHES

A starched fiberglass brush is a good quality brush that is less prone to tangling than an unstarched brush, but unstarched fiberglass brushes are also of good quality. Squirrel-hair brushes are also noted for their good quality. Feather brushes and other types of brushes are also available.

Two styles of brushes include (1) artistic brushes and (2) the zephyr brush. Fiberglass and animal-hair brushes are the most effective brushes for fingerprinting, not taking into account magnetic brushes. Feather brushes are generally used to clean fingerprints by removing excess powder from the background area. They are not as effective at developing latent fingerprints as fiberglass and animal-hair brushes. If you use multiple powder colors, you must have a brush for each different colored powder you use. Magnetic brushes use a magnetized end to collect the powder. They have a wand that is used to demagnetize the end and allow the powder to drop off the brush.

PROPER USES OF BRUSHES

Fiberglass and animal-hair brushes are loaded with powder by dipping the brush into the powder. Wipe the brush against the sidewalls of the container to load the sides of the brush. Using the sidewalls and not the bottom of the container helps prevent overloading the brush. Alternatively, pour a small amount of powder on a nearby surface and dip the ends of the brush into the powder. Whichever method you use, do not overload the brush. Hold the loaded brush over the surface to be fingerprinted and tap the brush, causing a small amount of the powder to fall onto the surface. Hold the handle of the brush between your thumb and index finger and twirl the brush back and forth in a clockwise–counterclockwise direction. Twirl the brush over the surface and allow only the brush fibers to touch the surface. An optional method is to use the brush in a paintbrush motion. Process over the area twice, using an up-and-down motion as well as a side-to-side motion.

Magnetic brushes are loaded by dipping the wand into a powder jar. Use a circular motion and run the powder over the surface to be fingerprinted. Do not allow the tip of the brush to make contact with the surface. Once the area has been processed, clean up excess powder and move the wand back to the powder jar. Release the plunger to deposit the powder back into the jar; then run the wand over the surface to clean up the area and return the excess powder back to the jar.

POWDERS

Aluminum flake powder is a flat, platelike structure. This powder has good adhesion properties and is highly reflective, making it the best choice for nonmagnetic powders—but it is expensive. Granular powder is a material that adheres to the aqueous parts of newer fingerprints and the fatty deposits of older fingerprints. This is a less effective powder than aluminum flake powders, but it is more cost effective. There are two types of magnetic powder. The first type is where the magnetic material actually develops the latent fingerprint, such as magnetic flake powder. The second type is where the magnetic powder is a carrier for the actual developing powder, such as black magnetic powder.

Powder Studies

Aluminum flake powder developed 96%–99% of the fingerprints on surfaces. Granular powder developed 80% of the fingerprint on surfaces. All other powders performed at levels below 80%. Magnetic flake outperformed aluminum flake powder, black magnetic powder, and granular powder. Magnetic powders outperformed aluminum flake and granular powders. The reason was the brush. Fiberglass and animal-hair brushes tend to develop the surface texture along with the fingerprint. Magnetic powders tend to develop more ridge detail and minimize the amount of surface texture developed.

Colored versus Black Powders

Colored powders make prints visible by developing contrast for photographic purposes. Black powders are a developing process for lifting and preserving fingerprints. AFIS (Automated Fingerprint Identification System) computers recognize black ridge detail and white background. For any other combination, the print and background must be inverted.

CLEAR LIFTING TAPE

Tape is sold in a variety of sizes: 1″ and 1½″, which are good for lifting from curved surfaces; 2″, which is the most popular size, since it fits nicely onto a backing card; and 4″, the palm-size tape, which takes lots of practice before using.

LATENT FINGERPRINT BACKING CARDS

Krome Kote cards are small sizes of poster board. They have a shiny side and a dull side. There is a limit of no more than two lifts per backing card. The front of the backing card (shiny side) contains some form of orientation label, such as up, front, back, etc. The back of the backing card (dull side) contains the case information, such as the case number, the date, the lifter's name or initials and ID number, the crime/incident, the location of the crime, the victim's name, a description of the item processed, the processing method used, and the location where the item was actually processed. In the lower right corner, draw a small sketch of where the lift was taken and place an X over this area. The sketch is used by the lifter and the examiner to clarify the location where the lift was taken.

TECHNIQUES FOR APPLYING TAPE TO THE SURFACE

Tape-Application Technique #1

Using the thumb of your dominant hand, place the tape on the latent fingerprint you are going to lift. If there are multiple latent fingerprint marks in an area, first examine the developed marks. Starting in the center of the tape, carefully smooth the tape out over the surface containing the developed latent fingerprint and work outwards. Place the thumb as far away from the end of the tape as possible (Figure 9.1). This will allow you room to hold the tape above the area where the latent fingerprint is.

This technique is very useful, especially on curved surfaces. The thumb places the tape directly over the developed latent fingerprints, maximizing the amount of the latent fingerprint lifted (Figure 9.2). The use of 1″ tape works best on curved surfaces. There are elastic tapes that conform to the curvature of the surface; however, they are difficult to then place on a latent fingerprint backing card. This process seems to accomplish both tasks easily and can be limited to lifting a single latent fingerprint at a time.

FIGURE 9.1 Image of a roll of tape that was unrolled enough to allow the fingertips to hold the non-roll end of the tape while placing the thumb on the smooth side of the tape.

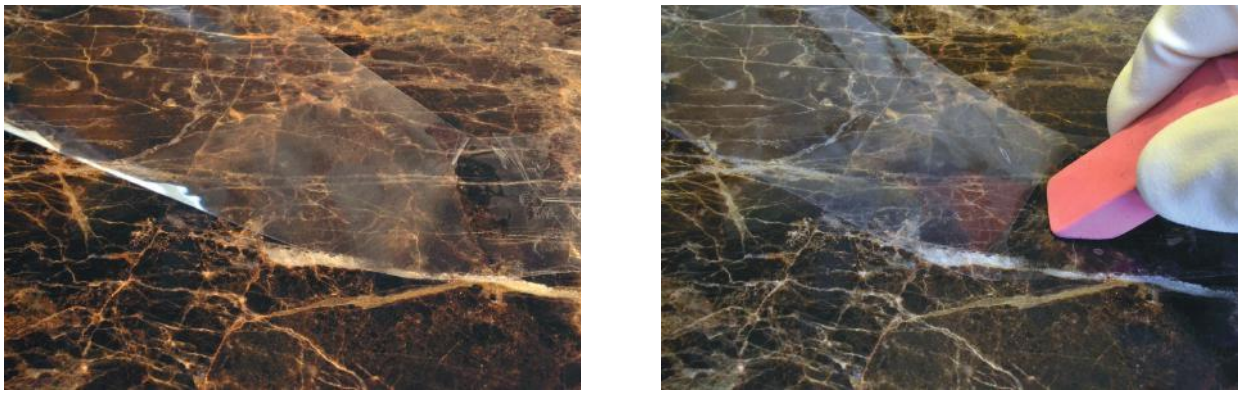
(a)

(b)

FIGURE 9.2 Images demonstrating the use of the dominant thumb to guide the tape onto the developed latent fingerprint; (a) is using the thumb to guide the tape onto the developed latent fingerprint and (b) is using the thumb to smooth the tape onto the surface around the developed latent fingerprint.

Tape-Application Technique #2

This process utilizes the flap end of the tape and attaches it to the surface near the developed latent fingerprints. Using your finger or a rectangular pink eraser, smooth the tape over the developed latent fingerprints (Figure 9.3). Be cautious not to cause creases or air bubbles to develop in the tape. This



(a) (b)

FIGURE 9.3 Images demonstrating the use of a pink eraser to smooth out the tape over the surface containing the latent fingerprint. (a) is attaching the tape onto the surface containing the developed latent fingerprints and (b) is using the pink eraser to smooth the tape over the surface containing the developed latent prints.

process is less useful on curved surfaces; however, it works very well on flat surfaces.

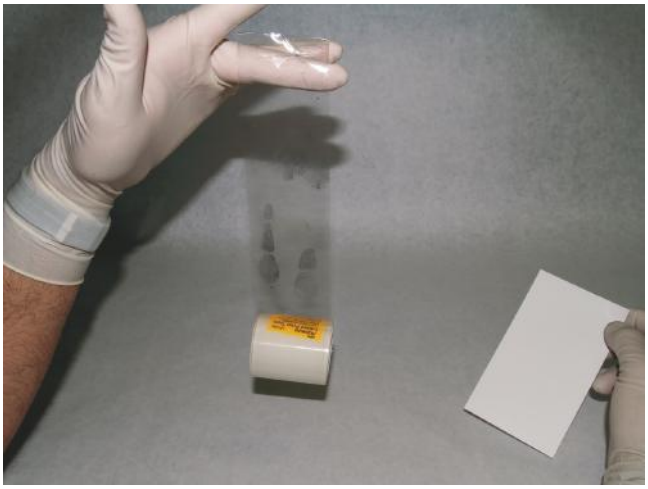
TECHNIQUES FOR ATTACHING TAPE TO BACKING CARD

Tape-Attaching Technique #1

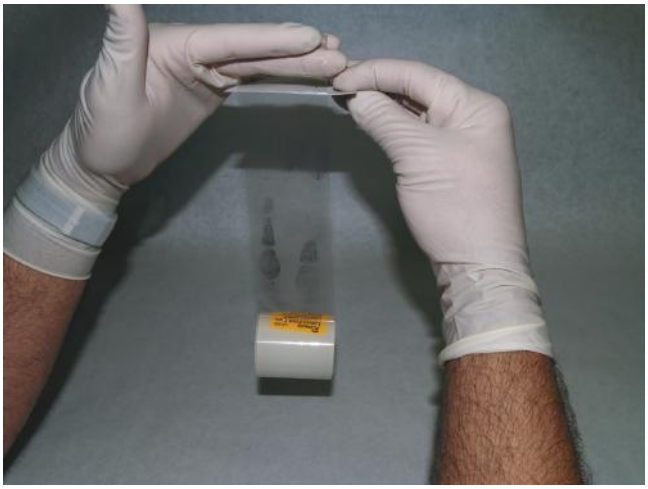
Attach the very top section of the sticky side of the tape to your nondominant middle finger. Allow the weight of the roll of tape to hang down (Figure 9.4).

Take a latent fingerprint backing card, shiny side down (Figure 9.5a). Hold the card parallel to the ground. Attach the end of the latent fingerprint backing card to the tape by placing the narrow end of the backing card between your middle finger and the developed latent fingerprint (Figure 9.5b). Use your non-dominant thumb to slowly smooth the tape onto the shiny side of the latent fingerprint backing card (Figures 9.5c and 9.5d). This technique minimizes or even eliminates creases and/or air bubbles in the tape as the tape is being attached to the backing card.

FIGURE 9.4 Image illustrating the attachment of the non-roll end of the tape to your non-dominant index finger.



(a)

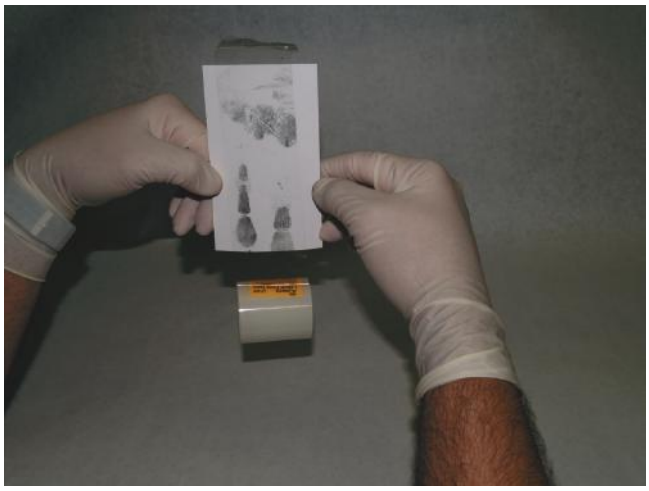


(b)

FIGURE 9.5 Images demonstrating technique #1 for attaching the backing card to the tape. (a) demonstrates attaching the adhesive side of the tape to the index finger of the non dominant hand, (b) demonstrates attaching the narrow end of the backing card, shiny side down, between the index finger of the non-dominant hand and the developed ridge. *(continued)*

(c)

(d)



(e)

FIGURE 9.5 (continued) Images demonstrating technique #1 for attaching the backing card to the tape. (c) demonstrates using the thumb of the non-dominant hand to smooth the tape onto the shiny side ofthe backing card, (d) demonstrates continuing to smooth the tape onto the backing card and (e) shows the tape attached to the backing card.

Tape-Attaching Technique #2

An alternative method is to completely remove the lifting tape from the surface, taking care to secure the flap end of the tape. Holding the tape, carefully attach the flap end of the tape to a surface such as a countertop (Figure 9.6a). Place a latent

(a)

(b)

(c)

FIGURE 9.6 Images demonstrating technique #2 for attaching the tape to the backing card. (a) demonstrates the lifting of the tape from the surface and inserting the backing card onto the surface, directly underneath the tape, (b) demonstrates using the pink eraser to smooth the tape onto the backing card, and (c) shows the tape attached to the backing card.

fingerprint card, shiny side up, on the surface directly underneath the raised area of the tape (Figure 9.6a). Carefully smooth the tape out over the surface of the card (Figure 9.6b). This technique may also be used to lift the developed latent fingerprint from the surface.

Tape-Attaching Technique #3

Another technique is to carefully lift the tape up, starting at the roll end of the tape, until a small amount of the tape remains on the surface. Place a latent fingerprint card, shiny side up, on the surface directly underneath the tape (Figure 9.7a). Carefully smooth the tape onto the latent fingerprint card (Figure 9.7b). As the tape is being smoothed out, ensure that the backing card remains in place until the tape is attached.

This technique is good unless there are multiple developed latent fingerprints in the same general area as the one you are trying to lift. If this is the case, caution must be used not to disturb the other developed latent fingerprints. If a nearby latent fingerprint will be damaged or destroyed, consider using technique #2, where the tape is secured to a nearby countertop or other similar surface.

EXTENDING A BACKING CARD

There may be situations when the card is not quite long enough for the lifted fingerprints. If this situation arises, simply add another backing card onto the end of the original backing card. Care must be taken to ensure that the latent fingerprints that are on the tape are not disturbed during this process, which may result in destruction of that portion of the latent fingerprints.

If the second backing card can be attached directly at the bottom or end of the first backing card—in a manner such that there is no gap between the two backing cards—without damaging any of the developed latent fingerprints, then attach the second backing card to the first backing card. If there is a risk of damaging any of the latent fingerprints, attach the second backing card by overlapping the top of the second backing card approximately 1/8″ on the first backing card (Figure 9.8).

The palm tape is very difficult to work with and requires much more practice than the smaller-sized tape. Practice these lifting techniques until you become comfortable with their use prior to actually using them on a scene.

MAKING PALM-SIZE CARDS

In the event you run out of palm-size backing cards or simply do not have any, one can easily make them from the smaller-sized backing cards. Place two smaller cards—shiny side down—on a clean surface. Place a piece of tape (Figure 9.9) to hold the two cards together.

Using 2″ Tape to Make Palm-Size Tape

In the event you run out of palm-size tape or do not have any, you can use the smaller tape widths such as 2″. Simply overlay the strips of tape approximately 1/8″. When you begin to remove them, start with the first piece of tape you placed on the surface (Figure 9.10a). This will allow you to pull up all the pieces simultaneously, keeping them together as a single piece of tape. The tape is then attached to a palm-size backing card (Figure 9.10b) or one that you made (Figure 9.9).

Trim Ends of Tape

Once the tape has been securely attached to the card, the edges of the tape should be trimmed (Figure 9.11). Keep in mind that there is information that must be written on the back side of the backing cards. If the tape is simply folded over onto the back of the backing card, this makes writing the information difficult and often ends up being a sloppy process. The jury consists of people who will be looking at this

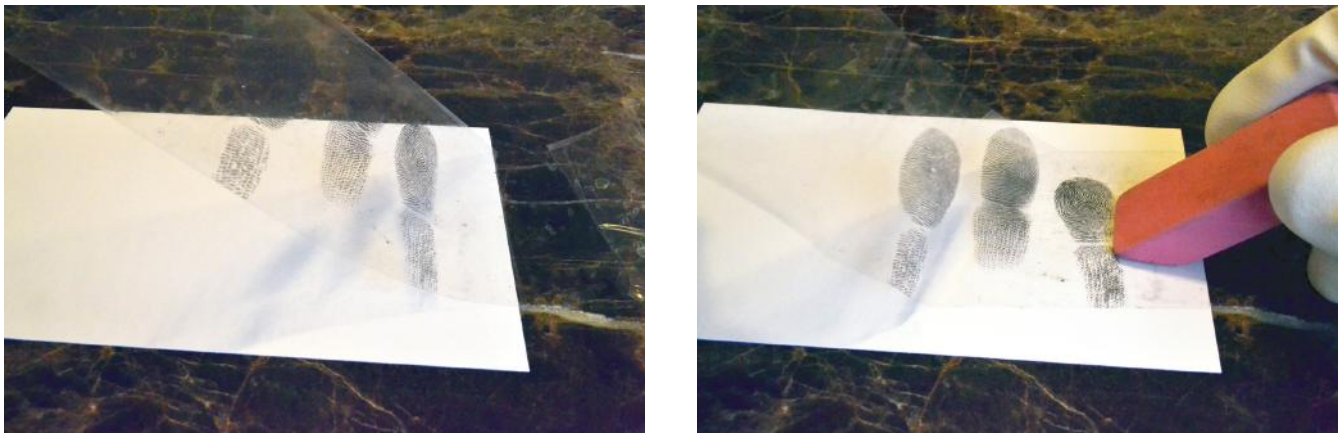
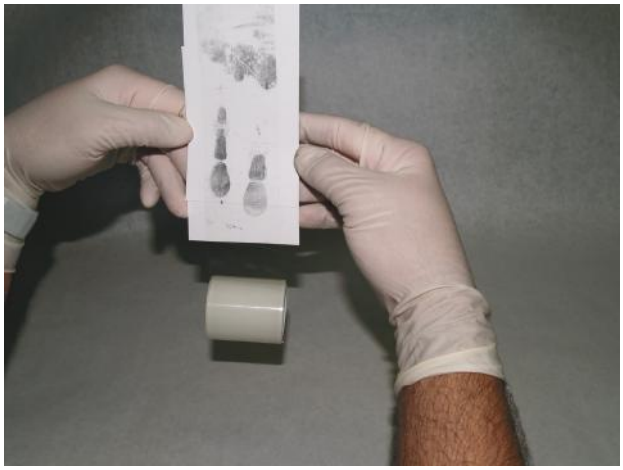
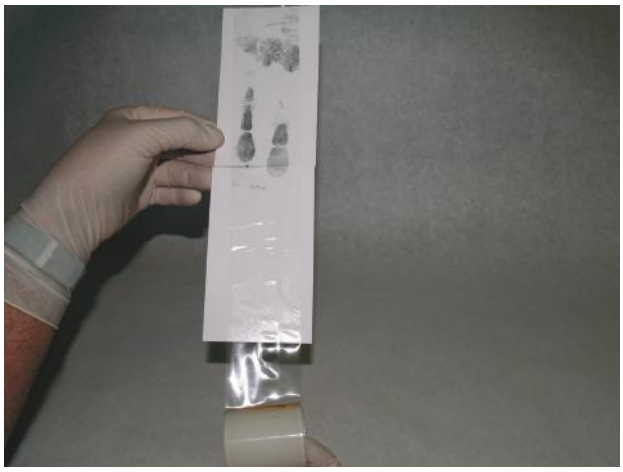


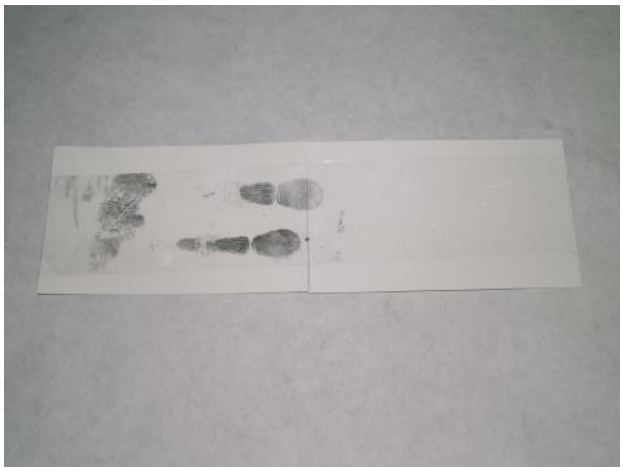
FIGURE 9.7 Images demonstrating technique #3 for attaching the tape to the backing card.



(a)



(a)



(c)

FIGURE 9.8 Images demonstrate the proper method to add another standard-sized backing card onto the narrow end of the backing card when the latent fingerprints on the tape will not fit on a single backing card; (a) demonstrates placing the second backing card onto the back of the initial backing card, (b) demonstrates moving the second backing card into proper position along the narrow end of the initial backing card, and (c) demonstrates placing the backing cards on the surface underneath the tape extending the long side of the backing card using another standard-sized backing card.

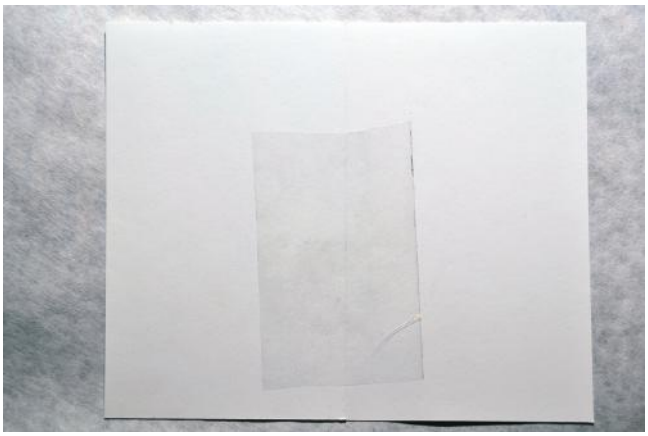


FIGURE 9.9 Image demonstrating the attachment of two smaller backing cards to make a larger palm-sized backing card.

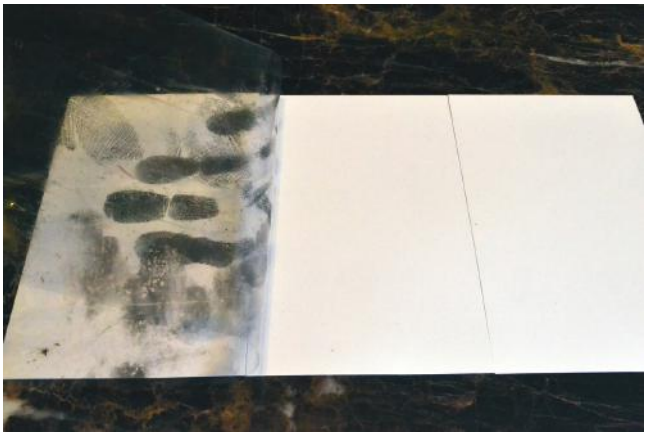
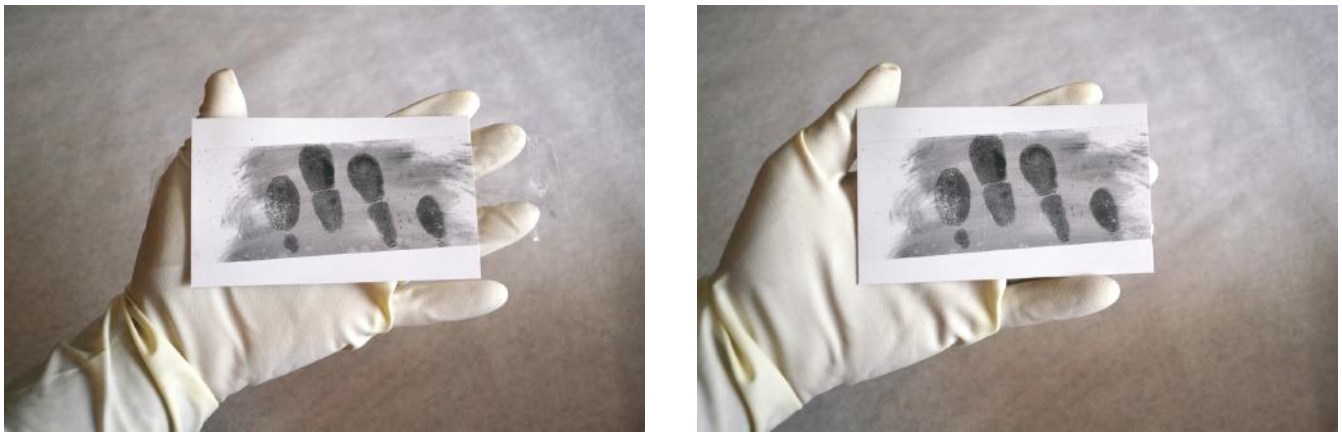


FIGURE 9.10 Images demonstrating the proper method to add another backing card when the latent fingerprints on the tape will not fit on a single backing card.



(a) (b)

FIGURE 9.11 Images demonstrating the trimming of the excess tape from the backing card rather than simply folding the tape onto the back of the backing card; (a) shows the uncut tape on the backing card while (b) shows the tape trimmed along the narrow ends of the backing card.

and judging your credibility as you testify. You do not want to come across as one who is sloppy; you want to present your evidence in a very professional manner.

Lifting the Latent Fingerprint Using Hinge Lifters

Hinge lifters are designed to combine the lifting tape and backing card as a single unit (Figure 9.12).

The tape is carefully pulled back from the backing card surface (Figure 9.13a). Carefully remove the plastic covering from the adhesive side of the tape. The sticky side is then applied to the surface containing the developed latent fingerprint (Figure 9.13b). It may be helpful to use an eraser to smooth the tape out over the surface.

Once the tape has been smoothed out over the surface, the tape is carefully removed from the surface (Figure 9.14a). The tape is then carefully folded back onto the surface of the pre-attached backing card (Figure 9.14b).

LIFTING LATENT FINGERPRINTS

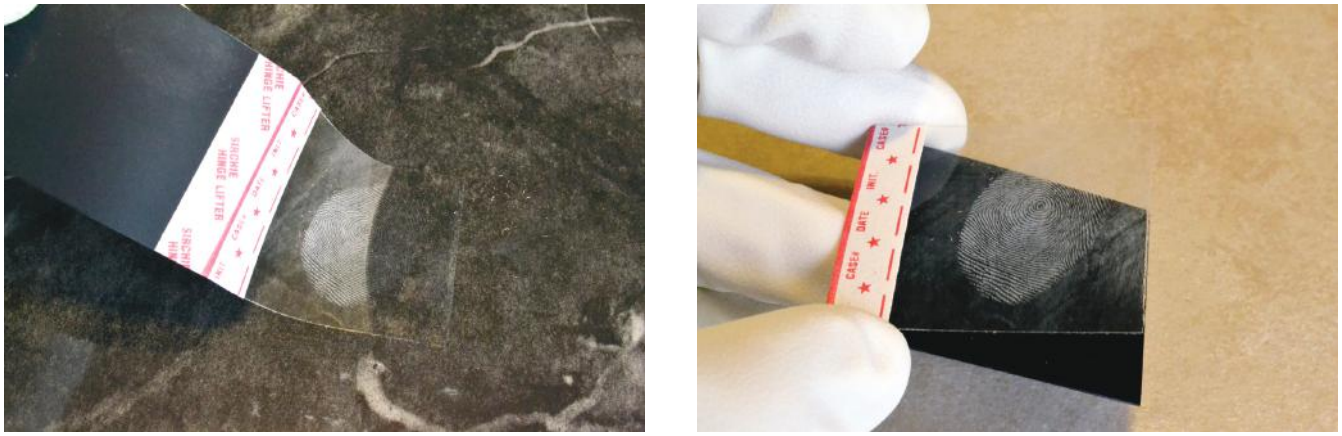
Lifting the Latent Fingerprint Using Rubber/Gel Lifters

Rubber/gel lifters are manufactured with the clear covering over the adhesive area of the lifter (Figure 9.15). The lifters are manufactured in black, white, and transparent and come in several different sizes.

FIGURE 9.12 Image of white, transparent, and black hinge lifters.

(a) (b)

FIGURE 9.13 Images demonstrating the proper method of separating the tape area from the backing card and smoothing the tape of the hinge lifter back onto the surface containing the developed latent fingerprint; (a) demonstrates the hinged lifter and (b) demonstrates attaching the tape to the surface containing the developed latent fingerprint.



(a) (b)

FIGURE 9.14 Images demonstrating the proper method of smoothing the tape of the hinge lifter back onto the backing card; (a) demonstrates removing the hinge lifter from the surface containing the developed latent fingerprints and (b) demonstrates the smoothing of the tape onto the pre attached backing card..

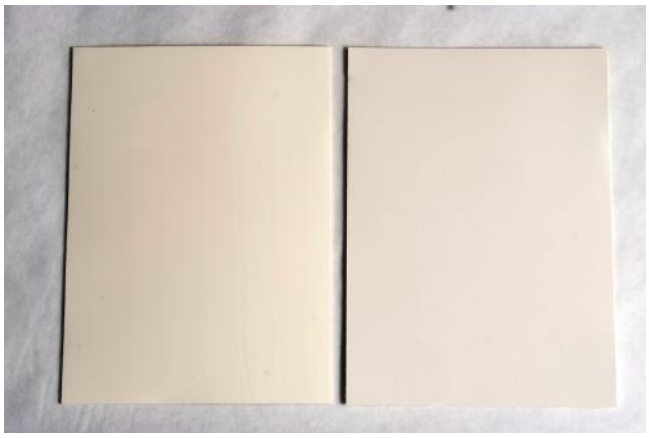
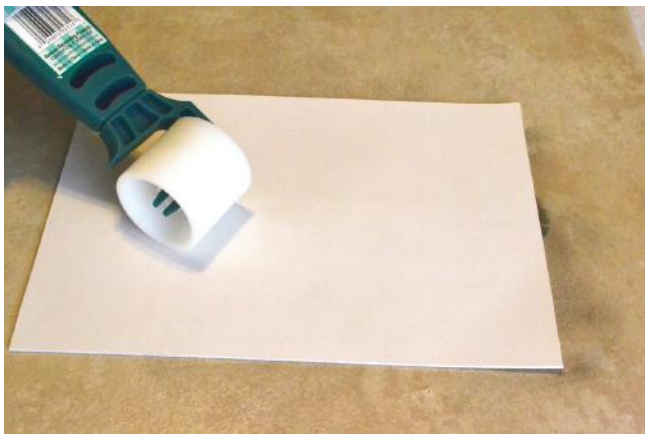


FIGURE 9.15 Image of a white palm-sized gel lifter.

The cover is removed and the lifter is carefully smoothed out over the surface holding the developed latent fingerprint (Figure 9.16a). A small ink roller or wallpaper roller may be more useful in smoothing the lifter out over the surface. Care must be taken to ensure that the lifter is not allowed to slide around on the surface as the lifter is being smoothed out.

Once the lifter has been properly smoothed out, it is carefully lifted off the surface (Figure 9.17a). The transparent cover is replaced by either attaching the gel lifter to the transparent film (Figure 9.17b) or by attaching the transparent film to the gel lifter (Figure 9.17c). The lifted latent fingerprint impression is reversed from what is normally lifted. The developed latent fingerprints must be inverted prior to being examined in an AFIS system. This can be done by photographing or scanning the impression on the lifter and inverting the image prior to printing out the final photograph.

(a)



(b)

FIGURE 9.16 Images demonstrate the proper method of using a wallpaper roller to smooth the gel lifter over the surface containing the developed latent fingerprint; (a) demonstrates using the wallpaper roller to smooth out the gel lifter onto the surface containing the developed latent fingerprint while holding the opposite end of the gel lifter and (b) is smoothing out the gel lifter onto the surface.

Lifting the Latent Fingerprint Using Special Lifting Tape

A wide variety of specially designed lifting tapes is commercially available (Figure 9.18).

The tape is unrolled, and the adhesive side is carefully placed onto the surface containing the developed latent fingerprint (Figure 9.19a). A pencil eraser may be useful rather than a roller in working the adhesive side of the tape into the rough texture of the surface (Figure 9.19b). This type of tape is also effective on rounded surfaces such as door handles, lightbulbs, etc., where normal lifting tapes do not easily conform to the curvature of the object.

Lifting the Fingerprint Using Forensic Sil

Properly set up the apparatus that is used to apply the Forensic Sil. Carefully dispense the Forensic Sil over the developed latent fingerprint (Figure 9.20). Take note to use the mixing tip to stir the gel as it is dispensed from the mixing tip, which will help to prevent air bubbles from forming. Be cautious when mixing the casting material with the mixing tip, taking care to prevent the tip from touching the latent fingerprint. Use a wide applicator tip or a wooden popsicle stick to smooth out the gel. If a wooden stick is used, it should be done quickly due to the fact that the gel sets up in a very short time.

(a)

(b)

(c)

FIGURE 9.17 Images demonstrate the proper method of placing the transparent cover over the lifter fingers (a) and (c); the gel lifter is attached to the transparent cover while (b) the transparent cover is being attached to the gel lifter.

FIGURE 9.18 Images of commercially available special lifting tape.

(a)

(b)

FIGURE 9.19 Images demonstrating the proper method of lifting a developed latent fingerprint using special lifting tape; (a) is attaching the special lifting tape to the surface containing the developed latent fingerprint and (b) is using the eraser from a pencil to smooth the special tape over the developed latent fingerprint.

Lifting the Latent Fingerprint Using Clear Glue

Office-type clear glues and other types of clear artistic-type glues, such as Elmer's Glue, provide a great lifting medium (Figure 9.21). Prior to using this technique, test a small area of similar surface to ensure that the glue will not adhere and remove some of the surface when it is lifted.

Apply a small amount of glue onto the surface containing the developed latent fingerprint (Figure 9.22a). Use a wooden tongue depressor, popsicle stick, or a stir stick to evenly smooth out the glue over the developed latent fingerprint (Figure 9.22b). When smoothing out the glue, care must be taken to ensure that the glue does not extend past the width of the lifting tape that will be used to lift the glue off the surface. This will allow enough room for the lifting tape to be securely attached to the backing card.

Allow the glue to completely dry. Lift the glue as described previously in the discussion of how to lift a latent fingerprint using clear lifting tape (Figure 9.23a). A disadvantage to using glue is that the glue is an adhesive; therefore, some or the entire adhesive may adhere to the surface containing the developed latent fingerprint. If the glue is not completely dry, it will not lift properly, resulting in damage to or complete destruction of the developed latent fingerprint. Once the developed latent fingerprint and glue have been removed from the surface, attach the tape to a backing card (Figure 9.23b).

If the width of the glue is greater than the width of the lifting tape, the tape cannot be securely attached to the backing card. This exposes the lifting card and tape to potential damage during storage if something were to become lodged between the tape and backing card.

Lifting the Latent Fingerprint Using Mikrosil

The same technique discussed in Chapter 14 on toolmark impressions may be used for lifting fingerprints. Gray Mikrosil may also be used to obtain ID fingerprints from unidentified or partially decomposed bodies where access to the fingers is limited.

Incidental Marks on the Lifting Tape

Any incidental marks on the lifting tape that appear on the backing card should be eliminated by simply drawing a large X through the incidental marks.

(a)

(b)

(c)

FIGURE 9.20 Images demonstrating the proper method of lifting developed latent fingerprints using Forensic Sil; (a) shows the developed latent fingerprint, (b) demonstrates the application of the Forensic Sil casting materials onto the surface containing the developed latent fmgerprint, and (c) shows the Forensic Sil casting materials covering the developed latent fmgerprint.

ADDITIONAL FINGERPRINT DEVELOPMENT TECHNIQUES

SPR Processing Method

Small-particle reagent (SPR) may be applied by spraying (Figure 9.24) or dipping. The surface to be processed is coated by spraying the solution onto the surface (Figure 9.24a). The excess solution may be carefully washed off using a small

FIGURE 9.21 Image of glue that is appropriate to use during this technique.

(a)

(b)

FIGURE 9.22 Images demonstrating the proper method to attach glue to the developed latent fingerprint prior to lifting the impression; (a) demonstrates the pouring of the glue onto the surface containing the developed latent fingerprint and (b) demonstrates the use of a stir stick to smooth the glue out over the surface containing the developed latent fingerprints.

(a)

(b)

FIGURE 9.23 Images demonstrating the proper method to lift the glue from the surface and attach the tape and glue to a backing card; (a) demonstrates attaching regular lifting tape over the developed latent fingerprint and glue, and (b) shows the tape and glue attached to a backing card.

bottle of distilled water (Figure 9.24b). Gently squirt or pour the water onto the surface, being careful not to use too much pressure on the developed latent fingerprints.

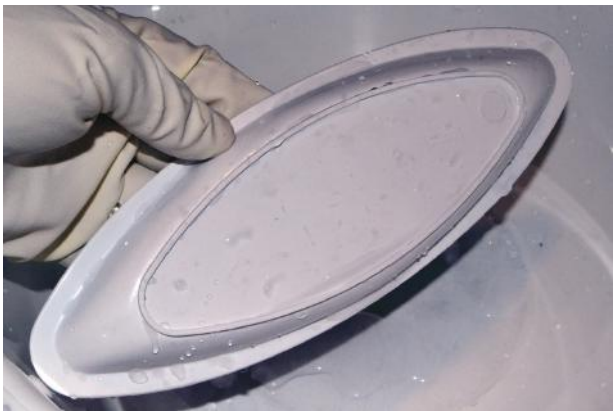
Iodine-Fuming Processing Method

Chamber Method

Place the article into a processing chamber, allowing it to hang from the top of the chamber. Place a glass dish with 1 g of iodine crystals in the chamber. Seal the chamber. Apply low heat to the dish containing the iodine crystals. Low heat is required to sublimate the iodine crystals into fumes. Observe the process, and when the background starts to be developed, stop the process by opening the chamber and safely evacuating the air. This can be done by using a vent hood or some other process that safely removes the iodine fumes.

Fixing Solution

Place the fixing solution into a laboratory spray gun. Spray the fixing solution onto the developed latent fingerprint. The developed latent fingerprint should change to a blue color. Wait 2–3 minutes and re-treat faint latent fingerprints.



(a)

(b)

(c)

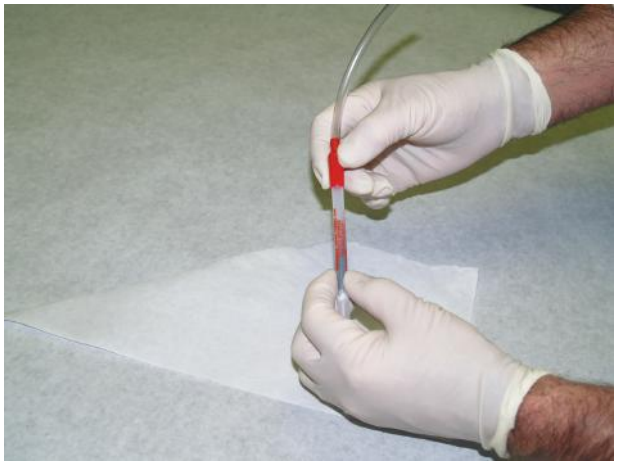
FIGURE 9.24 (continued) Images demonstrating the proper method to develop latent fingerprints using SPR; (a) shows a wet surface, (b) demonstrates spraying the SPR onto the wet surface, and (c) demonstrates the use of a water bottle to remove the excess SPR from the wet surface.

Spray Method

Use a fine spray mist and spray a light coat onto the article. A heavy coat will result in overdevelopment of the surface.

Fuming Gun Method

Commercially available fume tubes are available. An ampule inside the main part of the fuming gun contains the iodine.



(a)

(b)

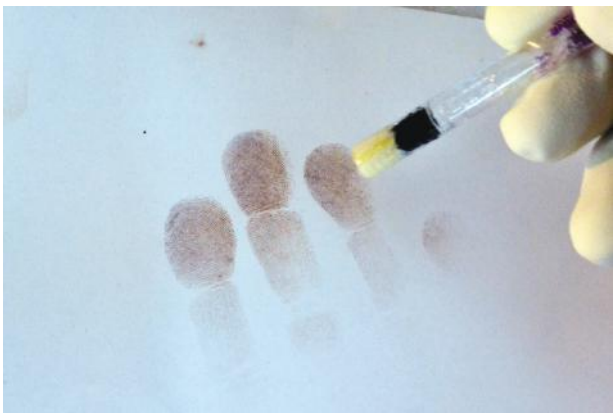
FIGURE 9.25 Images demonstrating the proper method to develop a latent fingerprint using an iodine fuming gun; (a) demonstrates the assembling of the fuming gun and (b) demonstrates using the assembled fuming gun to process a piece of paper for latent fingerprints.

A blowing tube is attached to one end of the fuming gun (Figure 9.25a). Generally there is only one end that will accept the blowing tube. Hold the fuming gun in the palm of your hand, completely covering the ampule. Open the stopped end of the fuming gun. Attach the blowing tube to the red cap at the opposite end. Crush the glass ampule. Place the blowing tube into your mouth and gently blow into the tube. As you are blowing into the tube, slowly wave the uncapped end of the fuming gun over the paper (Figure 9.25b). Do not inhale through the tube. Wait 3 minutes and apply a fixative solution to the developed latent fingerprints.

Print Enhancer Method

The print enhancer solution may be sprayed onto the article or the article may be dipped into the print enhancer solution. Commercially available print enhancer may also be used (Figure 9.26). Remove the end cap to the enhancer tube (Figure 9.26a). Crush the vial in the enhancer tube and remove the end cap. Gently wipe or dab the now-wet material over the developed latent fingerprint (Figure 9.26b).

(a)



(b)

FIGURE 9.26 Images demonstrating the proper method to enhance a developed latent fingerprint using iodine print enhancer; (a) shows the iodine print enhancer tube and (b) demonstrates the application of the wetted end of the iodine print enhancer tube onto the developed latent fingerprints.

Physical Developer Processing Method

This is a multiple step process that must be done in the prescribed order. The formulas for each solution can be found in Chapter 9 of the Complete Crime Scene Investigation Handbook.

Method #1

Step 1. Pour the working solution into a glass dish, such as Pyrex®. Fill the dish to approximately 20 mm deep with the working solution. Place the same amount of distilled water into three other glass dishes. Half fill a fifth glass dish with maleic acid solution.

Step 2. Test the solutions by going through steps 3 and 4 with a sample article that contains test latent fingerprints.

Step 3. Immerse the article in the maleic acid solution for approximately 10 minutes or until no more bubbles are seen coming from the article, whichever is longer.

Step 4. Immerse the article in the working solution. Gently rock the dish back and forth. Latent

fingerprints will begin to develop a dark gray color. Remove the article when the background appears significantly darker, or after 20 minutes. You may need to extend the time if the working solution is not fresh.

Step 5. Immerse the article in the first dish of distilled water. Wash the article for 5 minutes, occasionally rocking the dish back and forth.

Step 6. Immerse the article in the second dish of distilled water. Wash the article for 5 minutes, occasionally rocking the dish back and forth.

Step 7. Immerse the article in the third dish of distilled water. Wash the article for 5 minutes, occasionally rocking the dish back and forth.

Step 8. Transfer the article to photographic print washer. Wash the article for approximately 10 minutes in cold running tap water.

Step 9. Allow the article to dry at room temperature

Lightly developed latent fingerprints may be re-treated beginning with step 1. Step 3 may be omitted in the re-treatment process.

Method #2

Place five glass dishes, such as Pyrex, in the work area. Label the trays as Tray 1, Tray 2, Tray 3, Tray 4, and Tray 5. It is advisable to prepare the trays and place the proper solutions in the trays prior to actually beginning the development process.

Tray 1—Solution 1 (maleic acid): Place Solution 1 in Tray 1. Immerse the article in the solution for approximately 5 minutes. If the article is emitting bubbles, leave the article immersed in the solution until the article no longer emits the bubbles.

Tray 2—Solution 2 (redox working solution): Place 1000 ml of Solution 2 into a 2-L glass beaker. Place the beaker on a magnetic stirrer. Add 40 ml of Solution 3 to the beaker. Add 50 mL of Solution 4 to the beaker. Stir the solution for approximately 3–5 minutes. The solutions must be combined in the above order. After the solution has been combined, transfer the solution to Tray2.

Place Tray 2 on an orbital shaker. Immerse the article in the solution for 5–15 minutes. The shaking motion will assist in the development of the latent fingerprints. The length of time the article is in the solution will depend on the actual number of articles in the solution. If an orbital shaker is not available, manual shaking of the tray is acceptable.

Tray 3—water rinse: Place distilled water into Tray 3. Once the article is removed from Tray 2, it is immersed in Tray 3. Failure to rinse the article will result in the article becoming brittle.

The article is then dried. It can be air-dried or dried by applying heat to the article.

Tray 4—sodium hypochlorite: Place the sodium hypochlorite solution in Tray 4. Immerse the dried article into Tray 4 for approximately 15 seconds.

Tray 5—water rinse: Place distilled water into Tray 5. Once the article is removed from Tray 4, it is immersed into Tray 5. Rinse the article thoroughly. Failure to do so may result in deterioration of the specimen.

Sudan Black Processing Method

Sudan black is applied by either pouring the solution over the surface, spraying the solution onto the surface, or by dipping the item into the solution.

Shake the bottle containing the working solution. Pour working solution into a glass dish, such as Pyrex. Pour enough so that the article will be covered. Immerse the article in the working solution for approximately 2 minutes. The article may also be allowed to float on top of the working solution. Rinse the article under cold running tap water until the excess dye has been removed from the background.

Lightly developed articles may be re-treated.

Silver Nitrate Processing Method

The article may be dipped or painted with the silver nitrate solution. Allow the article to air-dry. The article is then placed under high-intensity light or direct sunlight to develop the latent fingerprints.

Gun Bluing Processing Method

Lightly fume the cartridge casings with cyanoacrylate. Do not fume the cartridge casings in a fuming chamber. Immerse the cartridge casing in the reagent. The cartridge casings may be gently rolled in the reagent solution. Once the latent fingerprints have sufficiently developed, remove the cartridge casing and immerse it in distilled water for approximately 2 minutes. Remove the cartridge casing from the distilled water and allow it to air-dry.

Acidified Hydrogen Peroxide Processing Method

Lightly fume the cartridge casings with cyanoacrylate. Do not fume the cartridge casings in a fuming chamber. Immerse the cartridge casing in the reagent. The cartridge casings may be gently rolled in the reagent solution. Once the latent fingerprints have sufficiently developed, remove the cartridge casing and immerse it in distilled water for approximately 2 minutes. Remove the cartridge casing from the distilled water and allow it to air-dry. The water bath stops the reaction.

DEVELOPING LATENT FINGERPRINTS ON PAPER EVIDENCE

Ninhydrin Processing Method

The item may be processed by spraying, soaking, brushing the working solution onto the surface, or drawing the item

through the ninhydrin working solution. Ninhydrin is not recommended for surfaces that have previously been wet.

Pour some of the working solution into a glass dish, such as Pyrex (Figure 9.27a). Pour enough solution into the dish so that the solution will completely cover the article. Submerge the article into the working solution (Figure 9.27b). Use a slow rocking motion with the dish containing the working solution (Figure 9.27c). This can be done by slowly raising one end of the pan, allowing the chemical to run to the lower end of the pan. Then lower the highest end, allowing the chemical to run to the other end of the pan. Repeat this process for several minutes.

(a)

(b)

(c)

FIGURE 9.27 Images demonstrating the proper method to develop a latent fingerprint using ninhydrin; (a) demonstrates the adding of the solution to the processing dish, (b) shows adding the article to the processing dish containing the ninhydrin, and (c) is rocking the solution back and forth across the article to be processed for latent fingerprints.

Remove the article from the solution. Allow the article to air-dry. The article is then placed in a humidified environment to accelerate the development process. This may be done by placing the article in a humidified chamber. The article may alternatively be placed in between a folded piece of clean white butcher paper. Use a steam iron and slowly pass the iron over the top of the white butcher paper. Be careful not to allow the iron to touch or set on the paper, as this will cause the paper to turn brown. The article may be re-treated in the working solution. In this case, it is the steam and not the heat that increases the development of the latent fingerprints (Figure 9.28).

Articles may be examined using normal lighting. The articles may also be examined with an alternate light source (ALS) with a wavelength of 470 nm, and a green filter may further enhance the developed latent fingerprints, especially faint, lightly developed prints. The article may also be examined using 530–505 nm with no filter, 490–505 nm using an orange filter, 590 nm using a red filter, or 450 nm with an orange filter (for manila folders and paper).

DFO Processing Method

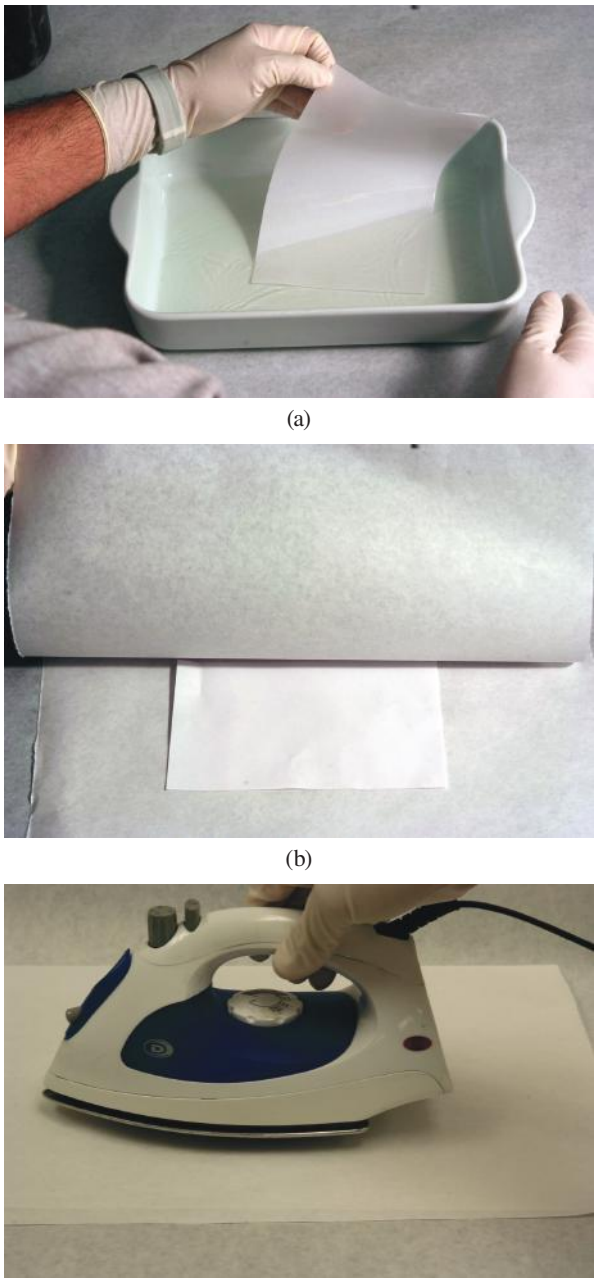
The most common method is to soak the item in the solution. Pour enough DFO (1,8-diazafluoren-9-one) solution into a Pyrex dish to completely cover the article. Submerge the article into the working solution. Use a slow rocking motion with the dish containing the working solution. This can be done by slowly raising one end of the pan, allowing the chemical to run to the lower end of the pan. Then lower the highest end, allowing the chemical to run to the other end of the pan. Repeat this process for several minutes.

Remove the article from the solution. Allow the article to air-dry. The dry item is then placed in a preheated oven. Preheat the oven to 100°C. An alternative method is to place the item in between a folded piece of clean white butcher paper. Use a steam iron (make sure the steam function is off) and slowly pass the iron over the top of the white butcher paper. In this case, it is the heat and not the steam that is necessary to promote the reaction. Be careful not to allow the iron to touch or set on the paper, as this will cause the paper to turn brown.

1,2-Indanedione Processing Method

The article may be dipped, sprayed, or washed with the solution. Allow the article to air-dry. Place the article in a preheated oven at 100°C for 10–20 minutes at 60% relative humidity. The humidity may be omitted.

Another option is to spray the article with zinc chloride. Cool the treated article using liquid nitrogen.

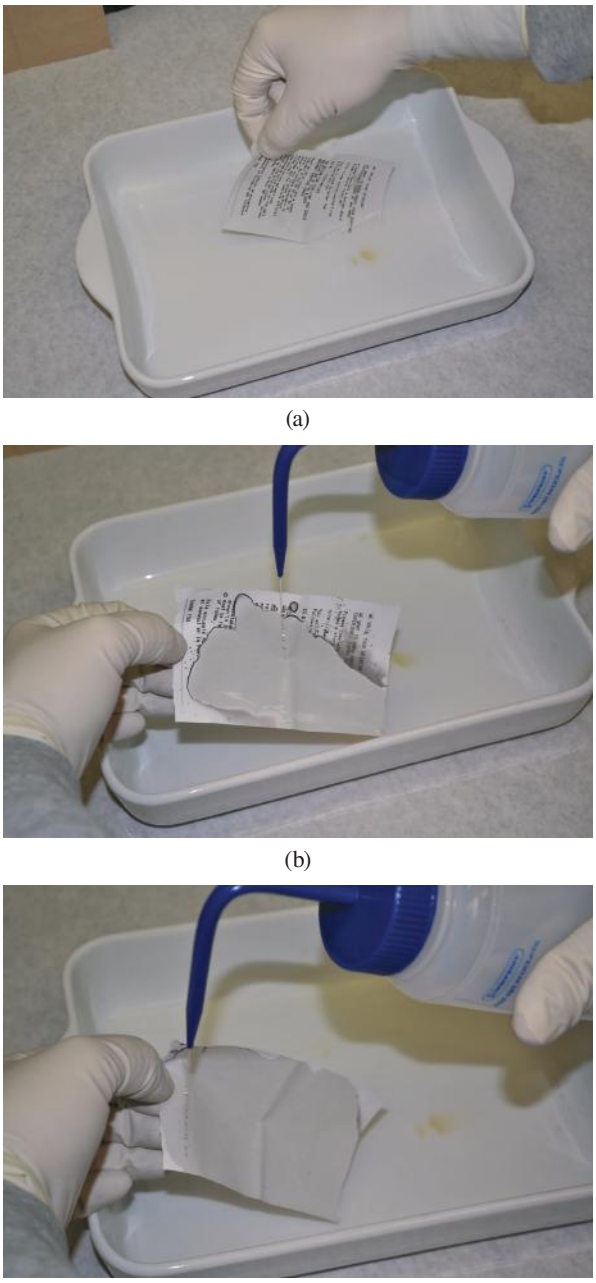


(a)

(b)

(c)

FIGURE 9.28 Images demonstrating the proper method of using a steam iron to develop latent fingerprints after treatment with ninhydrin; (a) demonstrates removing the processed article, (b) is placing the dried article between two pieces of clean, unused white butcher paper, and (c) demonstrates using the steam from an iron to stimulate the prints to develop.



(a)

(b)

(c)

FIGURE 9.29 Images demonstrating the proper method of using acetone to wash away the active layer from thermal paper; (a) is removing the thermal paper from the processing dish, (b) and (c) are rinsing the active layer from the thermal paper using acetone.

Thermal Paper Processing Method

Ninhydrin/Acetone

The same process described for ninhydrin is used. The thermal paper is then rinsed with acetone to remove the writing and the resulting discoloration of the active layer (Figure 9.29). Once the active layer has been rinsed from the paper, use the technique described in Figure 9.28 to stimulate the latent fingerings to develop at a quicker rate.

ThermaNin

The normal ninhydrin process may then be used to process the thermal paper, with some exceptions. Heating will cause the paper to turn dark and therefore should be avoided. The zinc chloride process uses polar solvents, and its use will also cause the thermal paper to turn dark.

1,2-Indanedione

The previously described 1,2-indanedione process is used.

DEVELOPING LATENT FINGERPRINTS ON ADHESIVE SIDE OF TAPE

Types of Adhesive

Rubber adhesive is the most common adhesive. Acrylic adhesive is less common. Conventional methods are ineffective because the materials stick to the adhesive materials.

Sticky-Side Powder Processing Method

Use a squirrel-hair brush, camel-hair brush, or a fiberglass brush. Dip the brush in the sticky-side powder solution. Paint the solution onto the adhesive side of the tape (Figure 9.30b). Allow the solution to remain on the adhesive side of the tape for approximately 30–60 seconds.

Gently rinse the solution from the adhesive side of the tape under a slow stream of cold tap water. This process may be repeated for faintly developed latent fingerprints. A rinse bottle containing distilled water may be used to carefully wash the excess solution from the adhesive side of the tape (Figure 9.30c). Allow the surface to dry.

Wetwop/Wet Powder Processing Method

Use a squirrel-hair brush, camel-hair brush, or a fiberglass brush. Dip the brush in the Wetwop or Wet Powder solution. Paint the solution onto the adhesive side of the tape (Figures 9.31a and 9.31b). Allow the solution to remain on the adhesive side of the tape for approximately 30–60 seconds.

Gently rinse the solution from the adhesive side of the tape under a slow stream of cold tap water (Figure 9.31c). This process may be repeated for faintly developed latent fingerprints. A rinse bottle containing distilled water may be used to carefully wash the excess solution from the adhesive side of the tape. Allow the surface to dry.

TapeGlo Processing Method

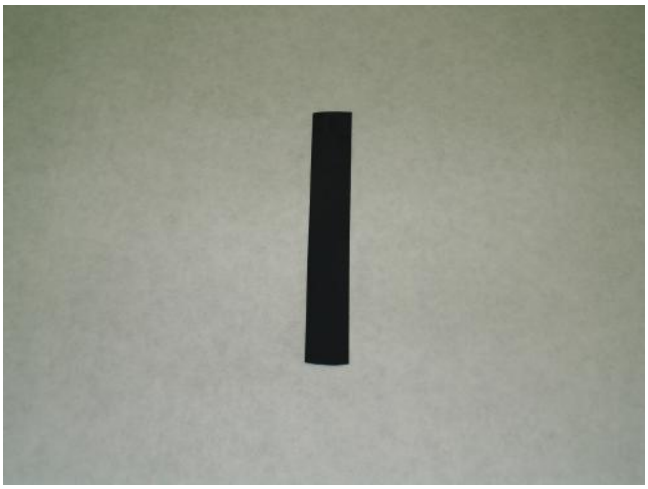
Use a disposable pipette or squirt bottle (Figure 9.32a). Saturate the sticky sides of the tape with the solution. Allow the solution to remain on the sticky side of the tape for 10–15 seconds (Figure 9.32b).

Gently rinse the solution from the adhesive side of the tape under a slow stream of cold tap water (Figure 9.32c). A rinse bottle containing distilled water may be used to carefully wash the excess solution from the adhesive side of the tape. Allow the surface to dry. View the processed tape using a 450-nm alternate light source and orange goggles.

Gentian Violet Processing Method

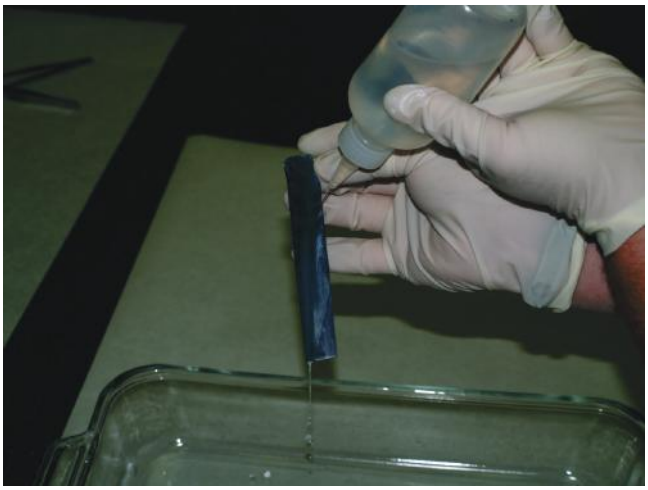
Method #1

Pour enough working solution into a glass dish, such as Pyrex. Pour enough so that the article will be completely covered.



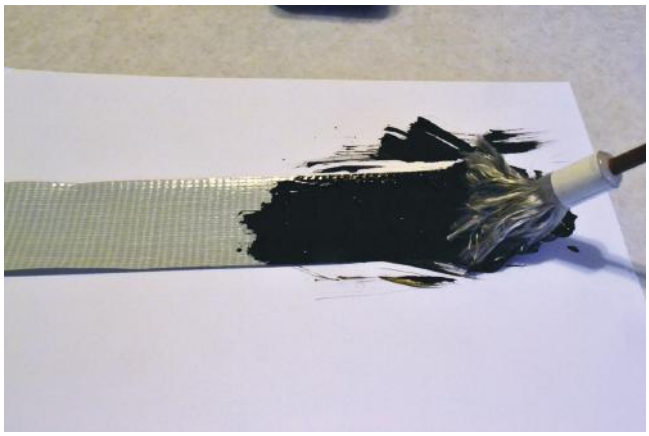
(a)

(b)



(c)

FIGURE 9.30 Images demonstrating the proper method to develop a latent fingerprint using sticky-side powder; (a) shows the black tape adhesive side up, (b) demonstrates using a brush to apply the sticky-side powder to the adhesive side of the tape, and (c) demonstrates using a wash bottle to gently wash the sticky-side powder from the adhesive side of the tape.



(a)

(b)

(c)

FIGURE 9.31 Images demonstrating the proper method to develop latent fingerprints using Wetwop; (a) and (b) demonstrates using a brush to apply the Wetwop to the adhesive side of the tape and (c) demonstrates using a wash bottle to gently wash the sticky-side powder from the adhesive side of the tape.

(a)

(b)

(c)

FIGURE 9.32 Images demonstrating the proper method to develop latent fingerprints using TapeGlo; (a) demonstrates using a small dropper to cover the adhesive side of the tape with the TapeGlo solution, (b) demonstrates the rocking of the processing dish, and (c) demonstrates using a wash bottle to gently wash the sticky-side powder from the adhesive side of the tape.

Draw the adhesive tape through the solution several times. If the article is not adhesive tape, the article may be immersed in the solution. Rinse the article with slowly running cold tap water. This process may be repeated for weakly developed latent fingerprints. This solution may be kept indefinitely.

Method #2

Pour enough working solution into a clean, dry glass dish, such as Pyrex. It is important that the glassware be cleaned with ethanol prior to use. Pour enough so that the article will be completely covered. Immerse the adhesive tape in the gentian violet solution for approximately 1–2 minutes. Rinse the article with slowly running cold tap water. This process may be repeated for weakly developed latent fingerprints.

Examine the developed latent fingerprints using an alternate light source in the wavelength range of 505–570 nm using a red filter.

BLOOD-CONTAMINATED EVIDENCE

Amido Black Processing Method

The article may be processed by spraying, dipping, or using a squirt bottle. Soak the article for 30–90 seconds with the developer solution. Rinse the article with the rinse solution. A final rinse of the article with distilled water completes the process. Allow the article to air-dry.

If the underlying surface absorbs the dye, the processing time may be shortened.

LCV Processing Method

Place the leucocrystal violet (LCV) solution in a fine-mist spray bottle. Spray the article with the solution. The article may be blotted with tissue or paper towel. Allow the article to air-dry. The article may be reprocessed for faintly developed latent fingerprints. The article may also be rinsed with a small squirt bottle containing distilled water.

Fuchsin Acid Processing Method

Place the fuchsin acid solution in a fine-mist spray bottle. Spray the article with the solution. The article may be blotted with tissue or paper towel. Allow the article to air-dry. The article may be reprocessed for faintly developed latent fingerprints. The article may also be rinsed with a small squirt bottle containing distilled water.

DEVELOPING FINGERPRINTS ON HUMAN SKIN

Direct-Transfer Method

Developing latent fingerprints on living individuals can be done using a direct-transfer method. Using a regular-sized latent fingerprint backing card works well. Increase the humidity on the card by placing it in a humidity chamber or placing it in your armpit. Lay the shiny side of the latent fingerprint backing card on the surface of the skin where the individual was touched, strangled, slapped, etc. Take care not to rub the backing card on the skin; simply lay the backing card on the skin. Remove the card from the skin by pulling it away, taking care not to rub the backing card on or across the skin. Use black magnetic powder and process the latent fingerprint backing card. Another alternative is to use adding-machine tape in place of the latent fingerprint backing card.

Cyanoacrylate

Prior to doing anything with a body, make sure you have obtained the necessary permission to proceed with the processing of the body. Often this is generally done only by the chief medical examiner or chief coroner. Once you have obtained the necessary permission, build a tent over the body. Place a test print on the inside of the tent. Place a beaker of hot water inside the tent to increase the humidity. Use either a wand, or portable hot plate, or sodium hydroxide cotton balls, or 0.5-N NaOH to vaporize the cyanoacrylate and begin the processing. Allow the processing to continue for about an hour, keeping an eye on the test print. Properly ventilate the tent. Process the areas suspected of containing latent fingerprints using black magnetic powder.

DEVELOPING LATENT FINGERPRINTS ON FIRE-SCENE EVIDENCE

There are a variety of processes that work well on fire-scene evidence. Removing the soot is the first obstacle.

FINGERPRINT FLOW CHARTS

Some of the methods work on different components of the latent fingerprint. By taking advantage of this, more than one method may be used on a single item of evidence. These processes must be done in a particular order; otherwise, the process becomes ineffective or destructive.

FINGERPRINTING EXERCISES

During the exercises, place large pieces of white butcher paper over the work space. Pour a small amount of powder onto a small area of a large piece of white butcher paper. There must be a separate brush for each of the powder colors. Do not mix brushes with different powder colors.

You will write a small description of (a) the item processed and (b) the results of each of the first four methods used. Each person will then compare the first four methods used and for each item that was processed.

Equipment needed:

1. Black silk powder
2. Black magnetic powder
3. Silver silk powder

4. Fluorescent powder
5. Small-particle reagent
6. Iodine fume
7. Fiberglass brush
8. Magnetic wand
9. 2″ Clear tape
10. 4″ Clear palm tape
11. White latent fingerprint cards
12. Black latent fingerprint cards
13. Clear glue
14. Wooden stir sticks (popsicle sticks)

Place latent fingerprints on the following items:

1. Glass bottle
2. Styrofoam cup or plate
3. Plastic drink bottle
4. Smooth piece of countertop-type surface
5. Rough piece of countertop-type surface

Exercise 9.1

Fingerprinting using black silk powder
Use black silk powder to develop latent fingerprints from items #1–5
Utilize 2″ clear tape to lift the developed ridge detail from the objects
Properly complete the fronts and backs of the backing cards

Exercise 9.2

Fingerprinting using colored powders
Use a colored silk powder to develop ridge detail from items #1–5
Utilize 2″ clear tape to lift the developed latent fingerprints from the objects
Properly complete the fronts and backs of the latent fingerprint cards

Exercise 9.3

Fingerprinting using fluorescent powder
Use fluorescent powder to develop latent fingerprints from items #1–5
Properly photograph the developed ridge detail on each of the surfaces
Utilize 2″ clear tape to lift the developed ridge detail from the objects
Properly complete the fronts and backs of the backing cards

Exercise 9.4

Fingerprinting using black magnetic powder
Use black magnetic powder to develop latent fingerprints from items #1–5
Utilize 2″ clear tape to lift the developed ridge detail from the objects
Properly complete the fronts and backs of the backing cards

Exercise 9.5

Fingerprinting using small-particle reagent
Use small-particle reagent to develop latent fingerprints from items #1–5
Photograph the developed ridge detail
Utilize 2″ clear tape to lift the developed ridge detail from the objects
Properly complete the backs of the backing cards

Discussion:
Discuss which process worked well on the specific surfaces used.

Exercise 9.6

Fingerprinting using Wetwop or Wet Powder
- Use Wetwop or Wet Powder to develop latent fingerprints from several pieces of tape
- Photograph the developed ridge detail
- Utilize 2″ clear tape to attach the developed latent fingerprints to the backing cards
- Properly complete the backs of the backing cards

Exercise 9.7

Fingerprinting using iodine fuming
- Use iodine fuming to develop latent fingerprints from a piece of paper
- Photograph the developed ridge detail

Exercise 9.8

Fingerprinting using additional method: _____
- Photograph the developed ridge detail

Exercise 9.9

Fingerprinting using additional method: _____
- Photograph the developed ridge detail

Exercise 9.10

Fingerprinting using additional method: _____
- Photograph the developed ridge detail

Exercise 9.11

Fingerprinting using additional method: _____
- Photograph the developed ridge detail

Photo Exercise 4.18A

Fingerprint Photography—General

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Place the camera on a tripod.
2. Adjust the camera to aperture priority mode.
3. Set the aperture to f/11.
4. Position the camera over the fingerprint impression so the impression is positioned in a landscape format.
5. Be sure to use the appropriate scale and scale placement when photographing.

Fingerprint evidence—using the appropriate lighting technique (both color and B&W film)

1. Photograph fingerprint on soda can developed with black powder using no filter.
2. Photograph fingerprint on glass window developed with gray powder using no filter.
3. Photograph fingerprint on knife blade developed with black powder using no filter.
4. Photograph fingerprint on mirror developed with gray powder using no filter.
5. Photograph fingerprint on mirror developed with black powder using no filter.
6. Photograph fingerprint on lightbulb developed with black powder using no filter.
7. Photograph fingerprint on magazine developed with black powder using no filter.

Photo Exercise 4.18B

Fingerprint Photography—Chemical Processes

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

Place the camera on a tripod.
Adjust the camera to aperture priority mode.
Set the aperture to f/11.
Position the camera over the fingerprint impression so that the impression is positioned in a landscape format.
Be sure to use the appropriate scale and scale placement when photographing.

Photographs of latent fingerprints developed with powders/chemicals and ALS

1. Photograph latent print developed with ninhydrin or DFO using ALS setting and filter
   - On piece of plain paper
   - On piece of newspaper
   - On piece of cardboard
   - Repeat the photographs using a green light
2. Photograph latent prints developed with superglue/RAM using ALS and filter
   - On piece of plastic
   - On piece of dashboard
   - On piece of ceramic tile
   - On piece of aluminum foil
3. Photograph a latent fingerprint using SPR

10 Evidence Collection and Packaging

SWABBING TECHNIQUES

If an open or unsealed container (such as a cup, box, etc.) that still has liquid in it is to be collected

1. Collect the swabs first, such as the mouth area, smudged bloodstains, etc.
2. Then empty out the liquid.
3. Place the container in a brown paper sack (BPS).
4. Properly seal the BPS with 2-in. tape.
5. Submit the container into the property room as evidence.

Open the swab package and remove the swabs (Figure 10.1a). If the package is to be used to hold the swabs after swabbing the surface, set the package aside in an uncontaminated area, such as on a paper sack or piece of unused butcher paper. Apply a single drop of distilled water to tip of each swab (Figure 10.1b). If the surface being swabbed is still wet, the water step may be eliminated. Using a single-use distilled water package is ideal for this process. Do not use tap water or normal saline from hospitals as the water source, as this may interfere with the DNA analysis. You may want to slightly flick (bend the swab's shaft back slightly and release) excess water from the swabs. Carefully rub the tips of the swabs as a single unit over the area to be swabbed (Figure 10.1c). For smaller surfaces, such as the trigger on a firearm, a single swab may be used to collect this evidence.

Most swabs are too long to properly fit into a coin envelope; therefore, the swabs must be shortened in order to fit into a coin envelope. Carefully bend the swab shaft in the middle to shorten the shaft length so that it may more easily fit into a coin envelope. You may either bend the swab shaft over (Figure 10.2a) or completely break off a portion of the shaft (Figure 10.2b), saving the cotton tip end of the swabs. Retrieve the swab package and return the swabs to the same package (Figure 10.2c).

Fold the original swab package so that it can fit into a coin envelope (Figure 10.3a). Place the swab/swab package into a coin envelope (Figure 10.3b). Fold the coin envelope flap (Figure 10.3c). If the coin envelopes contain an adhesive area that becomes activated when moistened, do not use the moistened adhesive. The flap will be sealed using 2-in. clear packing tape.

The swabs may also be placed in a glassine envelope, which is folded and placed into a coin envelope.

LIQUID SAMPLES

A liquid sample may be placed in a specimen container with a tightly closed lid. There are also special containers commercially available to collect these liquids. Use paraffin film to seal the caps to prevent leakage. The containers should be filled no more than half full, especially if the liquid is to be stored in a refrigerator or freezer. Place the cap on the vial and use the crimping device to seal the cap onto the vial (Figure 10.4).

The containers should then be placed in a plastic bag and sealed. Place the sealed plastic bag into a brown paper sack or evidence envelope and seal it. Care should be taken to ensure that the containers remain upright in the original package. This will prevent the liquid from leaking out and potentially contaminating other evidence. The plastic bag will also serve as a protective barrier in the event that the original container leaks some of the liquid. The outer markings on the paper sack should indicate the position in which the package should be stored.

TRACE EVIDENCE LIFTER

Trace evidence lifters are essentially large pieces of clear tape with special backing cards. Lifters may be used to collect hairs and fibers from large surfaces. Lifters are used to collects trace evidence from the surface rather than below the surface (such as carpet). There are also specialized rolls of lifting tapes designed for trace evidence collection, such as methanol-soluble and water-soluble tapes.

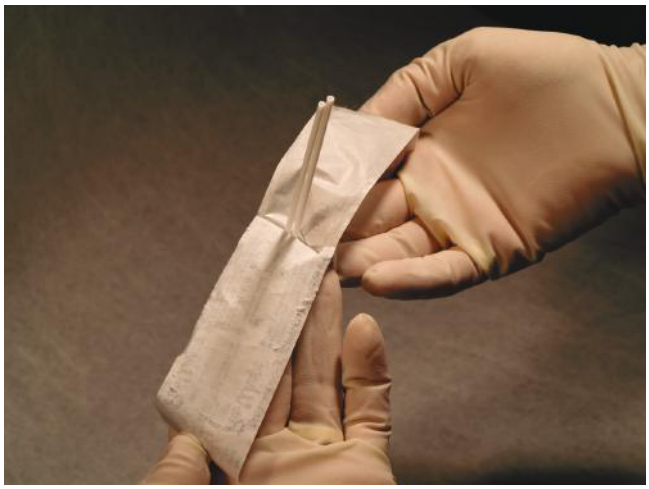
Remove the protective covering from the adhesive side of the trace evidence lifter. The adhesive side of the lifter is placed onto the surface (Figure 10.5a). Carefully smooth out the lifter over the surface. Lift the trace evidence lifter from the surface and reposition the lifter in another area to collect trace evidence from an adjacent area (Figure 10.5b). Examine the lifter after each lift. If the lifter contains a large quantity of trace evidence, properly secure that lifter and continue with a new lifter.

Once the area has been processed using the trace evidence lifter, it must be properly secured on a large piece of white backing paper (Figure 10.6). This backing paper is supplied with the lifters and is slightly larger than the lifter. The sticky side is ultimately placed onto this white backing paper. The trace lifter is then placed into a large paper sack, where it is properly labeled and sealed.

PAPER BINDLE OR PHARMACISTS FOLD

Put on a clean, unused pair of exam gloves and open a package of copy paper. Retrieve some of the paper from the package. Place the paper into a larger resealable plastic bag, such as a Ziploc® bag. Use this paper to make paper bindles.

Begin by making a paper bindle (sometimes referred to as a *pharmacists fold*). A paper bindle is made by folding a piece



(a)

(b)

(c)

FIGURE 10.1 Images demonstrate the proper method to open the swab package, apply distilled water to the swabs, and actually swab a surface.

(a)

(b)

(c)

FIGURE 10.2 Images demonstrate the proper way to shorten the shaft of swabs so they can fit into a coin envelope.

(a)

(b)

(c)

FIGURE 10.3 Images demonstrate the proper method to place the swabs in a coin envelope.

of clean copy paper into thirds lengthwise (Figure 10.7). The bottom third of the paper is then folded up. Holding the paper bindle by the center, carefully open the top of the bindle.

The top (open end) of the paper bindle is then folded over approximately ¼ to ½ in. The paper bindle is then folded in thirds in a manner that folds the flap that was just made down and over the bottom portion of the paper bindle. The paper bindle is then placed in a coin envelope and sealed. If there is a sharp object inside the bindle, make sure you mark this prominently on the outside of the package to warn others who will be processing the package contents. The paper bindle is sealed in a coin envelope, a paper sack, or heat-sealed in plastic.

EXERCISE 10.1

The student will create a paper bindle or pharmacists fold.

SCRAPING

Paint, blood, and other items may be collected by scraping methods. Avoid scraping blood due to the fact that scraping causes the scraped particles to become airborne, which may result in you breathing in the particles.

Hold the paper bindle under the area to be scraped. Using a clean, unused razor blade, scrape in a downward motion so that the scrapings will fall into the paper bindle (Figure 10.8a). Once the scrapings have been collected, drop the razor blade into the paper bindle (Figure 10.8b). Submit the blade because it may contain more of the sample, and the serologist or trace analyst can obtain more of a sample if needed. Make sure to mark the envelope stating there is a sharp object included inside the package.

EVIDENCE PACKAGING

Serology evidence must be packaged in breathable packaging, such as paper sacks, butcher paper, etc. Arson evidence must be packaged in an airtight container. Use clean 1-gallon paint cans. *Do not* use any other size for collecting arson evidence. Most trace evidence analysis instruments are designed to easily accept the 1-gallon cans.

BUTCHER PAPER

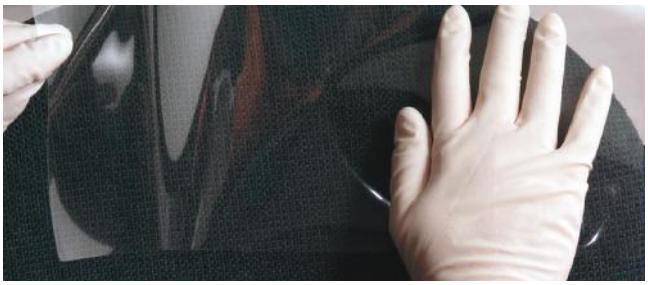
This process may be useful in packaging evidence in a manner that minimizes or eliminates specific evidence on an article from being transferred to other areas on the same article, such as gunshot residue. Begin by placing a large piece of white butcher paper on a properly cleaned and decontaminated table. Place a second large piece of white butcher paper on top of the first piece. The clothing item is then carefully placed on top of the paper (Figure 10.9a). Place another piece

(a)

(b)

(c)

FIGURE 10.4 Images demonstrate the proper method to secure a cap on a specimen vial using a special crimping tool.



(a)

(b)

FIGURE 10.5 Images demonstrate the proper method of using a trace evidence lifter on a surface to collect evidence.

FIGURE 10.6 Image demonstrates the proper method of attaching the trace evidence lifter to the large backing card.

of paper over the clothing article (Figure 10.9b). Carefully fold the ends back on themselves (Figure 10.9c). This step ensures that if there is any other trace evidence associated with the clothing, will remain inside the paper with the clothing item. Carefully fold the paper until it will conveniently fit into a paper sack (Figures 10.9d, 10.9e, and 10.9f).

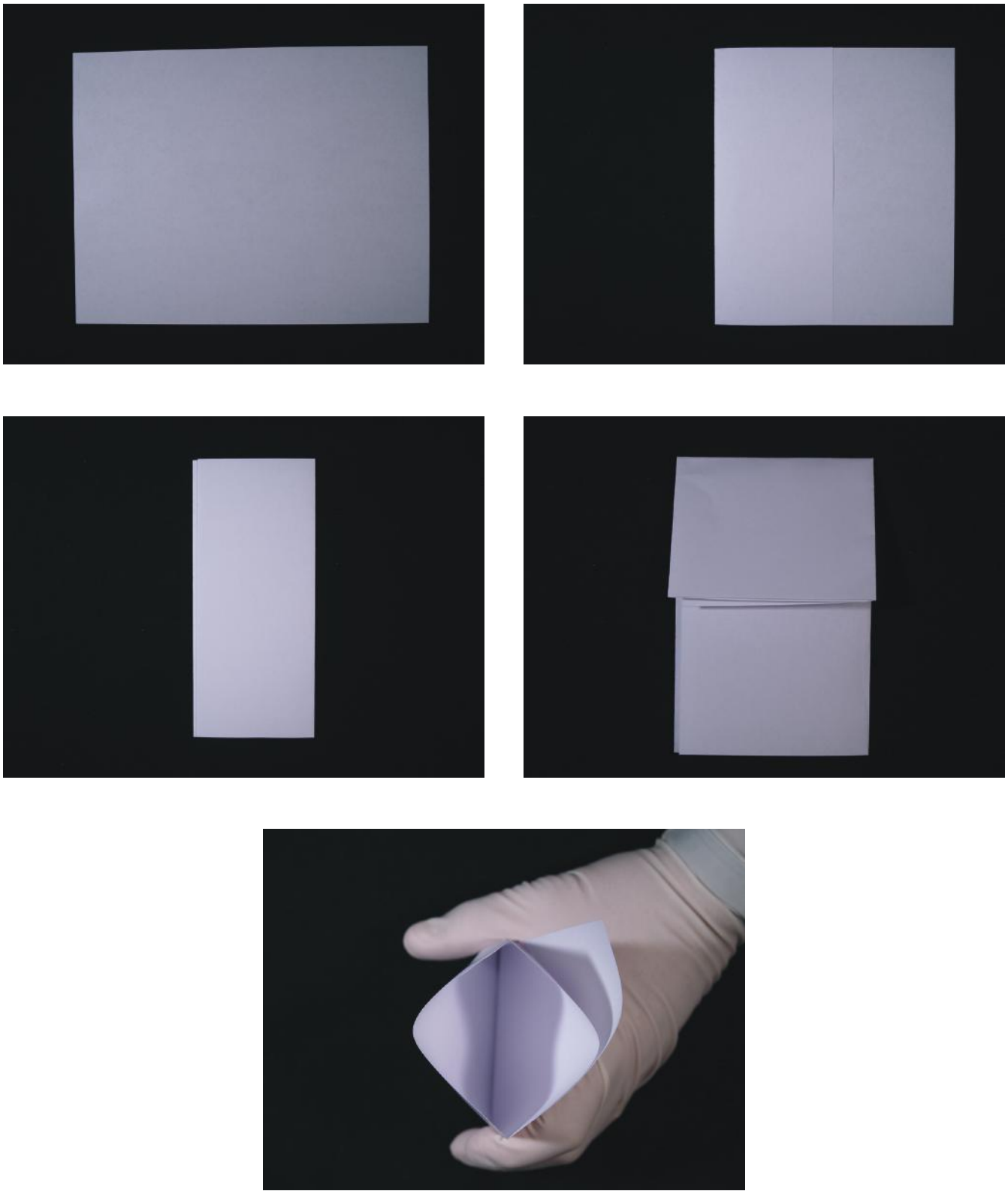
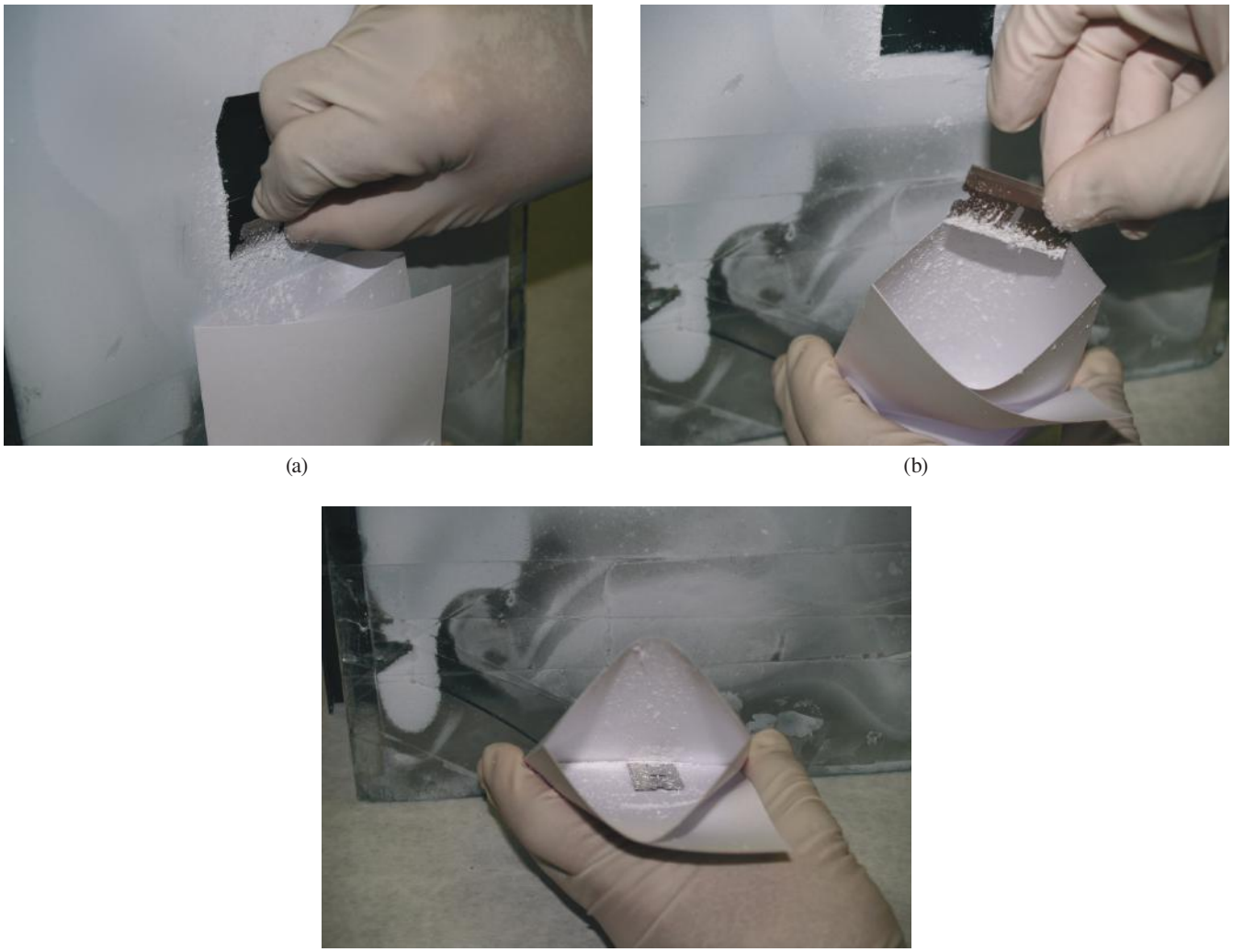


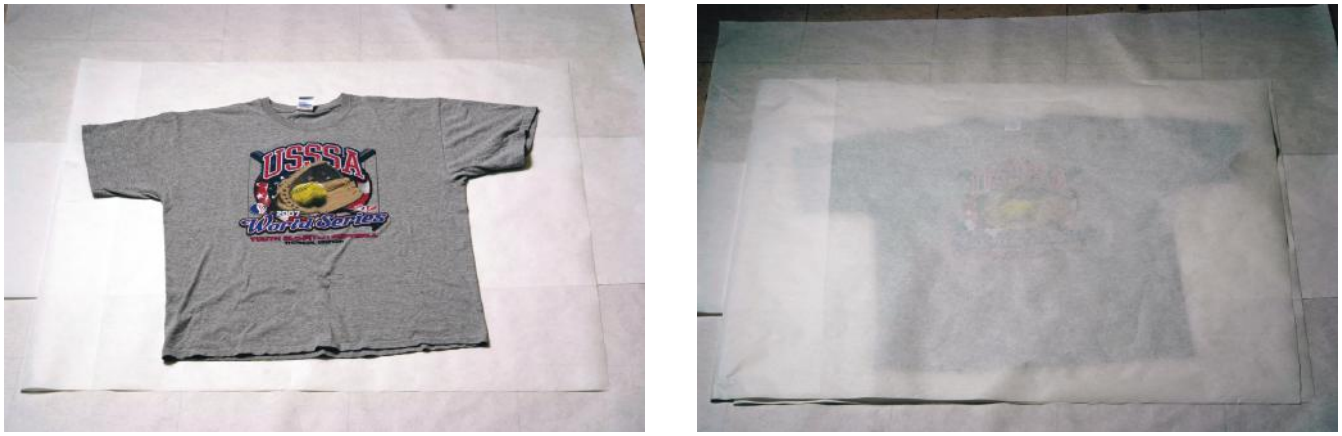
FIGURE 10.7 Images demonstrate the proper method for making a paper bindle or pharmacists fold.



(a) (b)

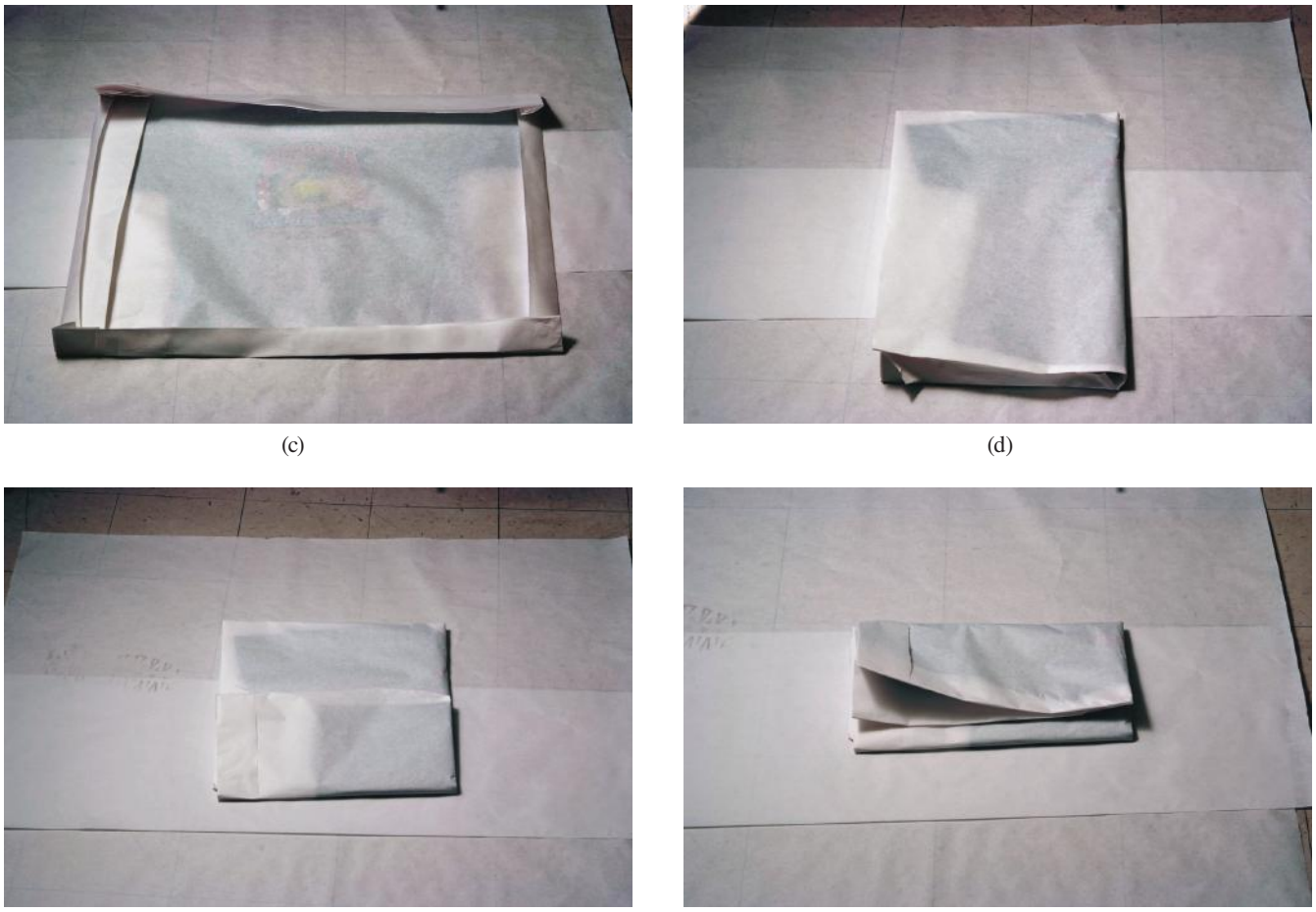
(c)

FIGURE 10.8 Images demonstrate the proper method of scraping evidence into a paper bindle or pharmacist fold.



(a) (b)

FIGURE 10.9 Images demonstrate how to use butcher paper to fold an article of evidence in order to protect the integrity of stain on the article from cross contaminating another area of the article. *(continued)*



(c) (d)

(e) (f)

FIGURE 10.9 (continued) Images demonstrate how to use butcher paper to fold an article of evidence in order to protect the integrity of stain on the article from cross contaminating another area of the article.

PROPERLY SEALING PACKAGES

The top of the package is folded over, creating a small flap. The flap on the package is taped closed with 2-in. clear packing tape (Figure 10.10a). The top edge of the tape should be placed as close as possible to the top of the package. A good rule of thumb is to use a pencil to determine if the tape is high enough. If a pencil can fit between the top of the package and the top of the tape, then the tape is not high enough. The ends of the tape extend past both sides of the package (Figure 10.10a). These ends of the tape are then folded onto the front of the package (Figure 10.10b,c). Ideally, you should also use only one piece of tape to seal the package.

Once the package is taped, it does not mean that the package is sealed. A seal occurs when the package and tape are marked identifying who sealed the package and dated as to when the package was actually sealed. The identification should include your initials and either your commission, badge, or employee identification number. Simply placing your initials on the package may result in confusion on the identity of the person sealing when there are multiple people who may have the same initials. ASCLD (American Society of Crime Laboratory Directors) only requires initials.

(a)

FIGURE 10.10 Images demonstrate the initial steps to sealing a package. This step is using 2-in. clear tape to secure the package. The flaps of the tape are folded onto the front of the package. *(continued)*

(b)

(c)

FIGURE 10.10 (continued) Images demonstrating the initial steps to sealing a package. This step is using 2-in. clear tape to secure the package. The flaps of the tape are folded onto the front of the package.

EXERCISE 10.2

The student will use a trace evidence lifter and lift hairs and/or fibers from their chair, clothing, or the surrounding floor. Once the trace evidence has been collected, the student will properly seal the trace evidence lifter in a paper sack.

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

Discussion:
Examine the trace evidence lifter and describe the characteristics observed.

CHAIN OF CUSTODY

Chain of custody is the chronological documentation of the evidence, identifying who had contact with the evidence from the time it was identified as evidence until the evidence item was admitted into court. There are two types of evidence: (a) those requiring further testing and (b) those not requiring further testing. In order for an officer to establish that an evidence item is what they say it is, it must be authenticated. The evidence may be authenticated by

1. Uniqueness in appearance, such as a serial number, officer's initials placed on evidence, etc.
2. Placing an evidence tag on the evidence, such as paper or heavy card stock taped or wired directly to the evidence item
3. Placing the evidence in a sealed container

There are two methods to the chain of custody:

1. Long method: where the officer must prove the evidence has been in continuous, secure possession at all times
2. Short method: where one must prove that the evidence was placed and maintained in a sealed, tamperproof container until it was tested, analyzed, and/or admitted into court.

The long method deals with the general submission of evidence in unsealed packaging. This is generally in the form of an evidence tag attached to the evidence. In this instance, everyone assigned to or that has access to the property unit that manages the evidence is in the chain of custody. In the short method, it deals with sealed evidence. Here only people in the chain of custody are the ones who enter the sealed packages. Everyone assigned to or who has access to the property unit that manages the evidence is now considered a custodian of the evidence and not actually in the chain of custody.

EVIDENCE NUMBERING

If your agency utilizes computer-generated numbering, then your problem is easy, unless you use evidence markers. Then your photographs with the evidence markers may not correspond to the report's evidence item number or evidence-room booking numbers. Either use (a) numerically numbered evidence or (b) alphabetically numbered evidence. If an item must be removed from another item and booked separately, consider using an alphanumeric numbering system, as this works very well. For example, item #5 is the pair of pants. Item #5a is the currency removed from the right front pocket of the pants (item #5). Otherwise, the evidence must be sequentially numbered: The pants are item #5, and the currency may now become item #75, depending on how many items were collected after the pants were collected and the discovery of the currency.

Section IV

Types of Evidence

11 Exercises for Physical Evidence

EVIDENCE

Evidence is defined as all the means by which any alleged matter of fact whose truth is investigated at judicial trial is established or disproved. Evidence can be placed into four broad types:

Testimonial evidence: This essentially consists of statements given under oath. Every witness provides this type of evidence.

Demonstrative evidence: This type of evidence occurs when the witness uses a model or reproduction of the item or performs some action that shows or demonstrates a point at issue.

Circumstantial evidence: This is evidence that may be presumed. This can put items of physical evidence in perspective. This is sometimes the most overlooked evidence. The relevancy of circumstantial evidence is based primarily on logic, reasonableness, good sense, and good judgment. For example, evidence presented that a suspect is an expert shot with a rifle may not have any bearing in a murder case, but if it is proved that the victim was killed from a great distance with a rifle, this could create an inference of guilt.

Physical evidence (real evidence): This is evidence that the actual object exists.

CHARACTERISTICS OF PHYSICAL EVIDENCE

Class Characteristics

Physical evidence can be placed into groups with other items having similar properties, such as soil, fibers, wood, others, size, color, common manufacturing patterns, taxonomic classifications, etc.

Individual or Identification Characteristics

This evidence is unique to a specific individual source, such as broken pieces of plastic, fingerprints, toolmarks, fired bullets, etc.

Locard's Exchange Principle

Physical evidence has been used increasingly since 1928. This is the same year that Locard stated his theory of transfer evidence, which states that when two surfaces are in contact with each other, there is a partial transfer of material from one to the other.

> Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value.
>
> **Professor Edmond Locard**
> *Father of Locard's Exchange Principle*

Physical Evidence and Investigative Questions

There are instances when someone will ask for evidence to be collected "just in case." This is a bad pitfall. Potentially everything within the scene would fall into this "just in case" category. The purpose of evidence is to answer one of the investigative questions: who, what, when, where, why, and how.

CLOTHING DOCUMENTATION

Clothing contain trace evidence such as hairs, fibers, paint, bloodstains, gunshot residue (GSR), etc. Another reason to document clothing is that the clothing may be heavily bloodstained. Proper photographic documentation may allow the photos to be used rather than opening the bloodstained clothing. Outside analysts may also need access to the clothing. Properly documented clothing may allow the analyst to use your documentation, thereby eliminating the need for the analyst to personally examine the clothing.

The same photo documentation philosophy used to document bloodstains may also be used on clothing. The process begins with proper overall photographs (a) without scales and (b) with horizontal and vertical scales. Remember to properly document and collect any visible trace evidence such as hairs and fibers. Once the initial photographs have been taken, this is an ideal time to document and collect this type of evidence. Document and collect anything that may be disturbed when markers are placed on the evidence.

Cut Clothing

Clothing may be cut during stabbing incidents. Proper scale placement follows the same principles as documentation of bloodstains and bullet defects. Each defect in the clothing is marked. Additional overall photographs are taken showing the marked defects, the horizontal scale, and the vertical scale. If there are numerous defects on the clothing, it may be helpful to label the markers. Proper midrange photographs are taken to depict which defect is actually being photographed. Proper examination-quality photographs are taken of each defect.

Torn Clothing

The process of documenting torn clothing differs slightly from cut clothing or clothing containing bullet defects. The defect in torn clothing may be long and irregularly shaped. The markers may be used to properly mark the entire damage to the clothing. If there are multiple tears, it may be necessary to label the markers for each tear. The students will document the characteristics of several items of damaged clothing in Exercises 11.1 through 11.3.

EXERCISES

The students will document the characteristics of several items of damaged clothing.

EXERCISE 11.1

Cut Clothing:

EXERCISE 11.2

Torn Clothing:

EXERCISE 11.3

Bullet Defect in Clothing:

PHOTO EXERCISE 4.19

Clothing Documentation: Cut, Torn, and Bullet Defects

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place a white T-shirt that has been shot, cut, and torn on a table.
2. Place the appropriate length and width scales.
3. Place the camera on a tripod.
4. Adjust the camera to aperture-priority mode.
5. Set the aperture to f/11.
6. Position the camera over the defect so that the defect is positioned in a landscape format.
7. Photograph the overall clothing item.
8. Place markers on clothing with multiple defects.
9. Place an L scale appropriately next to the defect.
10. Take the appropriate midrange and close-up photograph of the defect.
11. Take the appropriate examination-quality photograph of the defect.

12 Exercises for Serological Evidence

TYPES OF BIOLOGICAL/ SEROLOGICAL EVIDENCE

Blood: Blood is possibly the most common of the evidence types.

Contact or touch DNA: Individuals who touch items may transfer their skin cells onto that object. Simply wearing gloves prevents the leaving of fingerprints. However, gloves do not prevent the deposition of contact DNA, because people wearing gloves still touch themselves. When an object comes in contact with another object, DNA from one item may be transferred to the other item. Frequency or length of touch may affect whether or not contact DNA is left. An item that is simply bumped or very lightly touched may not have contact DNA transferred. A steering wheel has a much greater chance of containing contact DNA. People must touch the steering wheel for extended periods of time, increasing the likelihood they will leave DNA evidence behind.

Semen: Semen is common to sexual assault cases. Fewer than 50% of males ejaculate during a rape. However, we will always look for this type of evidence.

Bone/tissue/teeth: This type of DNA evidence may be left at extremely violent scenes.

Hair: This evidence contains mitochondrial DNA unless a root is attached, which contains nuclear DNA.

Fingernails: Fingernails may contain a suspect's DNA. During altercations, a victim may scratch the suspect. Fingernails left at the scene may also contain tissue,

Saliva: There are instances when the suspect may lick the victim. In other instances, the victim licks the suspect, although this is not common.

Urine: Research indicates that even though the components of urine (ammonia) break apart the cells, these chemicals do not destroy the DNA.

Sweat: This evidence is very subtle and may take a trained and very observant eye to see. It is less visible if the sweat is still wet.

Fecal matter: As the fecal matter is extruded from the body, skin cells from the rectum are being transferred from the rectal wall onto the exterior surface of the fecal matter. The exterior of the fecal matter contains the desired DNA. *Do not swab the inside of the fecal matter.*

Buccal swabs: These are DNA samples collected from the cheek (buccal) area of an individual. They are required to eliminate victims and others from a mixture. Note that serology labs are forbidden from putting victim/nonsuspect DNA into CODIS (Combined DNA Index System).

Author's opinion on collecting buccal swabs: Crime scene investigators collect unknown evidence and the buccal swabs are known DNA evidence. If the crime scene investigator also collects buccal swabs, there may be an issue that arises when unknown evidence could possible come in contact with known evidence. To eliminate this from ever becoming an issue, have the detective, other investigator, or other officer collect the buccal swabs. This leaves the crime scene investigator to collect the unknown evidence. If this is not possible, process the scene and secure the evidence in one location in your vehicle, such as the trunk or a rear-seat area. Collect the buccal swab and store it away from other evidence, such as in the passenger front-seat area. Process and submit the scene (unknown) evidence. Retrieve the buccal swabs (known evidence) and submit them separately from the scene (unknown) evidence.

DNA ISSUES

Decomposition fluid issues are destructive to the DNA analysis process. Dirt contains enzymes that are DNA destructive. The ultraviolet (UV) rays in sunlight contain short-wave UV, which is also DNA destructive.

EXERCISES

EXERCISE 12.1

During this exercise, the student will properly collect swabs from a drink container. The student will also properly package, label, and seal the swabs.

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:
Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:	Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging Used:	Submitted By:	Submitted To:

FIGURE 12.1 This is a portion of a form that may be useful in documenting evidence collected from a crime scene.

13 Exercises for Trace Evidence

TRACE EVIDENCE

Trace evidence can take many forms. It is typically small and less obvious than other types of evidence. It is also the most fragile of all evidence. Consequently, it is possibly the most overlooked type of evidence and can include:

Clothing
Footwear
The body
Tools
Weapons
Vehicles
Many other sources

The following sections outline some of the kinds of trace evidence in more detail.

Abrasives

This type of evidence is commonly used to vandalize vehicles. Abrasive compounds settle in the oil and fuel. Examine areas around the engine pump and fuel filter. Dried abrasives may be placed in coin envelopes, paper sacks, or plastic. Liquid samples may be collected using specimen containers or special liquid-collection vials.

Abrasive known samples are collected while processing a scene and you locate possible abrasives that may have been used in the crime. Collect known samples and package and submit them separately from the unknown evidence.

Adhesives/Calks/Sealants

This evidence includes compounds used to seal windows and doors and is generally found around windows. These types of compounds may be transferred to a tool. The compounds are collected by (a) scraping, i.e., by collecting scrapings around pry marks or other marks consistent with forced entry, and (b) collecting dislodged clumps. If tools contain this type of evidence, allow the toolmark examiner to remove the materials to prevent any inadvertent marks being added to the tool. Collect the tool and package it in the most appropriate packaging.

Bank Security Dyes

Bank dyes may also contain a gas that resembles tear gas. It may be possible to link the dye back to a bank chain or geographical region. Dyes are collected by dry swabs or by collecting the entire clothing article containing the dyes. If there are large amounts, samples may be collected and placed in coin envelopes, paper sacks, paper bindles, or plastic bags.

Building Materials

These materials may become dislodged during the process of forcing entry into a structure. This evidence can range from sheetrock, to wood pieces, to metal pieces as well as many other materials. The packaging material is dependent on the type and size of the materials collected. Paper sacks and boxes often are sufficient.

Chemicals of Unknown Origin

There are numerous chemicals used to commit crimes. Most common are acids thrown at people or moving vehicles. Dangerous chemicals are also used to manufacture drugs such as methamphetamines. You must ensure that the chemical is safe to collect, i.e., that (a) the area is safe to enter (e.g., a meth lab) and (b) the liquids are collected using specimen containers and other liquid-collecting systems.

Cigarettes and Tobaccos

Some cigarettes and tobaccos are unique. Some of the cigarette butts may contain valuable DNA. Some tobacco may be linked to a specific smoke shop that may have videos of the customers. Collect the evidence using coin envelopes, paper sacks, or plastic bags.

Cigarette and tobacco known samples are collected while processing a scene and you locate possible cigarette and/or tobacco evidence. Collect known samples and package and submit them separately from the unknown evidence.

Explosives and Explosives Residue

If the materials are properly collected, it may be possible to link a particular residue to a known source. The packaging material is dependent on the type of residue. Never collect or handle live explosives, as this is the job of the bomb techs. Paper sacks or airtight containers are sufficient to package the materials. This type of evidence is generally stored in secure bunkers maintained by the local bomb squad or the ATF (Bureau of Alcohol, Tobacco, Firearms and Explosives).

Feathers

Feathers are used in coats, bedding, and many other areas. Feathers may be linked back to a common source. Feathers are generally packaged in paper sacks.

Feather known samples are collected while processing a scene and you may locate possible sources of feather that may serve as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Fibers

Fibers are among the most overlooked evidence by investigators because of their size. These can be classified into two categories: natural and synthetic. Natural fibers are those found in nature that have not been greatly altered in physical composition or characteristics. Natural fibers include

1. Vegetable fibers such as cotton, linen, and flax
2. Animal fibers such as sheep wool, angora, and silk
3. Mineral fibers such as asbestos

Synthetic fibers are manufactured from synthesized chemical compounds that are then formed into fibers. Synthetic fibers include

1. Acetates
2. Olefin, polyethylene, polyesters, nylons as well as metallic and glass fibers

The analyst may be able to identify the dye in a fiber, the thickness of a fiber, etc., but first the analyst must locate the fiber evidence. The use of an alternate light source (ALS) may be helpful in locating fiber evidence. There is no single wavelength or filter color that can be used on *all* fibers; therefore you must use all wavelength and filter color combinations.

Possible locations of fiber evidence include

1. Persons
2. Vehicles
3. Tools of crime, such as a knife, gun, blunt object, etc.
4. Clothing

Fiber evidence is easily collected using trace evidence lifters or adhesive lifters. Single fiber strands may be collected by using tweezers and placed in a glassine envelope, which is then placed in a coin envelope.

Fiber known samples are collected while processing a scene and you locate possible sources of fiber that may be useful as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Glass

Glass is a reasonably hard, transparent or translucent material composed of fused inorganic materials. Glass has a wide variety of chemical compositions. Physical observations of glass could be the thickness, color, uniformity, curvature, etc. When microscopic glass chips are examined in an effort to associate two items, the physical, optical, and elemental properties are all very important. These types of examinations may eliminate samples as having possible origins.

Possible locations of glass evidence include

1. Persons
2. Tools of crime
3. Clothing
4. Vehicle, etc.

Glass is generally collected and packaged in paper sacks. Small amounts may be packaged in coin envelopes.

Hair

Hair be grouped by racial origin and is determined and classified as

1. Caucasoid
2. Negroid
3. Mongoloid
4. Austrazoid
5. Mixed origin

Race is based on skull shape and not skin color. Hair can by grouped by body location:

1. Scalp hair
2. Pubic hair
3. Body hair

Some analysts say that, more often than not, they can conclusively eliminate a person as a source, but rarely can they absolutely associate a hair with a given individual. This is where DNA comes into play. Animal hair can easily be differentiated from human hair using a microscope.

The root of the hair is the most valuable section of the hair. It provides the identification portion of the hair. This information is provided through the use of nuclear DNA. The shaft of the hair is less valuable but still helpful. It may provide the maternal lineage. This information is provided through the use of mitochondrial DNA. The use of an ALS may be used to search for hair evidence. There is no single wavelength or filter color that can be used on *all* fibers; therefore you must use all wavelengths and filter color combinations. This is primarily due to the various colors used to dye hair.

Possible locations of hair evidence include

1. Persons
2. Vehicles
3. Tools of crime, such as a knife, gun, blunt object, etc.
4. Clothing

Hair evidence is easily collected using trace evidence lifters or adhesive lifters. Single hair strands may be collected using tweezers and placed in a glassine envelope, which is then placed in a coin envelope.

Lubricants

Lubricants—mainly motor oils and other machinery oils—may be able to link the evidence back to a common source due to the additives different oil companies add to their oil products. This type of evidence is generally collected in a specimen container. Liquid-collection systems may also be used.

Lubricant known samples are collected while processing a scene and you locate possible sources of lubricants that may serve as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Metals

When tools are used to gain access to a structure, vehicle, or other area, metal fragments may be shaved or broken off. This evidence is generally packaged in coin envelopes, paper sacks, or boxes, depending on the size of the metal. Caution should be used to ensure that the metal does not poke through the packaging.

Paint

Paint is one of the more common types of trace evidence found at a crime scene. Paints belong to a class of substances referred to as *protective coatings*. The basic paint type can be determined through chemical analysis.

Paint is composed of three principal parts:

1. Binders, which hold all components together
2. Pigments, which supply paint with color, hue, and saturation
3. Modifiers, which affect the paint's durability, gloss, flexibility, hardness, etc.

Binders are broken down into two types:

1. Lacquer, which is a film that forms by the simple evaporation of the liquid's solvent system
2. Enamel, which is a film that forms by chemically cross-linking a number of its components (usually requires an exposure to oxygen, temperature, and chemical reaction of special initiators)

The pigments can be either organic or inorganic. Paint films can be investigated according to a number of their physical and chemical characteristics. Paint is examined by macroscopic and microscopic equipment.

Possible locations of paint evidence include:

1. Persons
2. Tools of crime
3. Clothing
4. Vehicle (exterior and under carriage)

Paint evidence is generally collected by scrapings. Clothing containing paint evidence should be collected.

Paint known samples are collected while processing a scene and you locate possible sources of paints that may serve as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Plants and Plant Materials

When an individual walks through a field or area containing plants, parts of the plants may become lodged in the clothing. It may be possible to identify the region or area where the materials originated. Collect the entire plant material. Full plants are packaged in paper sacks or boxes. Smaller materials may be packaged in coin envelopes.

Polymers

A polymer is a fancy word for *plastics*. It may be possible to link a polymer to a common source and rarely to a known source. Polymers are packaged in paper sacks or boxes, depending on the size of the evidence collected.

Polymer known samples are collected while processing a scene and you locate possible sources of polymers that may serve as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Rope/String/Twine

These items may be used to tie victims up, secure stolen property, etc. It may be possible to fracture-match a piece of rope to a known source. This type of evidence is often packaged in paper sacks.

Safe Insulation

This type of insulation differs from the typical home or building insulation. This insulation adheres to clothing very readily and may be collected by trace evidence lifter, paper sacks, coin envelopes, etc. If insulation evidence is on clothing, collect the entire clothing item and package it in an appropriate package.

Safe insulation known samples are collected while processing a scene and you locate possible sources of safe insulation that may serve as evidence about the crime. Collect known samples and package and submit them separately from the unknown evidence.

Soil

Soil is a complex and ever-changing mixture of living organisms, decaying organic matter, water, mineral fragments, etc. Soil has the potential for determining the likeliest area for where an event occurred. Each type of soil is different in certain areas. Each type may exist within a square yard or a few

square miles. This evidence may be packaged in paper sacks or specimen containers. If specimen containers are used, ensure that the soil is properly air dried.

Soil known samples are collected while processing a scene and you locate possible sources of soils that may provide useful evidence about the crime. Collect known samples such as from tire tracks that lead to and from the scene, etc., and package and submit them separately from the unknown evidence.

Soil alibi samples are collected while processing a scene and you locate possible sources of soil samples that may be associated with the crime. Be aware of the need to collect alibi samples such as the suspect's residence, the suspect's workplace, and other locations that suspect is known to frequent.

Tape

Tape evidence may be linked to a known source through fracture matching. It may also be linked to a common source through the tape fibers. This evidence is collected by securing the sticky side of the tape to a nonadhesive surface such as wax paper. The wax paper may be sealed in paper sacks or boxes.

Tape known samples are collected while processing a scene and you locate possible sources of tape that may have been used in the crime. Collect known samples, such as the entire roll of tape and not simply samples from the roll of tape, and package and submit them separately from the unknown evidence.

Wood and Pieces of Wood

When one kicks in a front door or other similar action, wood fragments may become attached to the clothing. It may be possible to link the wood pieces to a common source. The packaging material is dependent on the size of the pieces collected, such as paper sacks. coin envelopes, boxes, etc.

EXERCISES

The use of an alternate light source (ALS) will be performed on biological fluids to provide a visual identification of potential stains. The use of an ALS to locate stains is beneficial, since we do not need to spend unnecessary time documenting and collecting nonevidentiary stains such as drink and food stains. After the action is performed, write a brief description of the positive reaction.

EXERCISE 13.1

Documentation of Blood, Semen, Urine, and Hairs/Fibers Using Blue Light

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

EXERCISE 13.2

Documentation of Blood, Semen, Urine, and Hairs/Fibers Using a Blue Light and Orange Filter

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

EXERCISE 13.3

Documentation of Blood, Semen, Urine, and Hairs/Fibers Using a Blue Light and Yellow Filter

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

EXERCISE 13.4

Documentation of Blood, Semen, Urine, and Hairs/Fibers Using a UV Light

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

EXERCISE 13.5

Documentation of Hairs/Fibers Using a Red Light Alone and with Orange and Yellow Filters

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

EXERCISE 13.6

Documentation of Hairs/Fibers Using a Green Light Alone and with Orange and Yellow Filters

Item No.:	Item Description:				Location Item Found:				Identified By:	Collected By:
Latent Fingerprint Method:		Successful:	☐ Yes	☐ No	No. Cards:	Presumptive Test Used (Method):	☐ Pos.	☐ Neg.	Packaging used:	Submitted By:	Submitted To:

PHOTO EXERCISE 4.20

Alternate Light Source: Body Fluids, Hair, and Fibers

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Manual Mode	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. Place the camera on a tripod.
2. Attach the shutter release cable to the camera.
3. Adjust the camera to program manual mode.
4. Set the aperture to f/11 and the shutter speed to initially 10 s.
5. The shutter speed may need to be adjusted depending on the output of your particular ALS.
   a. Photograph body fluid stains with appropriate ALS setting and filter
   b. Photograph hairs using ALS and filter
   c. Photograph fibers using ALS and filter

14 Exercises for Firearms and Toolmark Evidence

FIREARMS AND FIREARM CATEGORIES

Firearms evidence may be useful in linking the firearm to the projectile, to the casing, and to the shooter. *Every weapon we come into contact with at a crime scene should be considered an unsafe hazard*!

The two categories of firearms are handguns and long guns. The five styles of firearms are as follows:

Single shot
Revolver
Semi-automatic
Automatic
Shotgun

A *single-shot* firearm has to be loaded manually. A *revolver* has a rotating cylinder and holds 4 to 24 cartridges. The types of revolvers include a double action and a single action. In the case of a single-action firearm, the hammer has to be cocked before each firing. A *semi-automatic* fires one round each time the trigger is pulled, and cartridges are loaded in a magazine. The types of semi-auto pistols include (a) safe action, where the hammer is not exposed, (b) double action, and (c) single action, where the hammer must be cocked before each firing. An *automatic* firearm fires the cartridges loaded in a magazine as long as the trigger is pressed and held. A *shotgun* is capable of firing pellets (referred to as *shot*) or a solid projectile (referred to as a *slug*).

SEMI-AUTO MAGAZINES

A single-stacked magazine orients the live rounds in a single row. A double-stacked magazine orients the live rounds in two rows.

AMMUNITION

Ammunition is composed of four parts:

1. A casing or cartridge casing
2. A projectile or bullet
3. The primer
4. The gunpowder

Types of ammunition include: rimfire (generally .22 caliber or smaller; hammer strikes cartridge rim), centerfire (hammer strikes center of cartridge), full metal jacketed hollow points, full metal jacketed flat nosed or round nosed, lead hollow points, and lead round nosed.

Shotgun ammunition is different from other ammunition and is referred to as *shotshell*. The shotshell contains additional components—the wadding and/or a shotcup—which will not be present in slugs.

REVOLVERS

The documentation of a revolver is obviously different from that of a pistol due to the fact that the cylinder is not in a fixed position when it is opened, as the magazine is. The direction the cylinder rotates should be documented. In Figure 14.1, the image Figure 14.1a has a downward and to the left rotation, while Figure 14.1b has an upward and to the right rotation. The rectangular area is actually the stop, and the beveled slot allows the revolver's stop mechanism to rotate into the cylinder stop. This mark is not identical on every revolver manufactured, but such marks should be somewhere on the cylinder.

Opening the cylinder without any additional markings often leads to confusion as to which firing chamber is directly under the hammer. This can be avoided by using a marker to mark the cylinder on both sides of the top strap of the revolver (Figure 14.2a). Carefully open the cylinder. A photograph may be taken at an angle from the top showing the contents of the cylinder as well as the markings you put on the cylinder (Figures 14.2b and 14.2c).

Once the cylinder has been marked and photographed. Open the cylinder and record the positions of the fired cartridge casings and live cartridges.

The documentation of the firearm and firearm-related evidence may seem to be a task that is not very important. However, consider a revolver with a fired cartridge casing in the fourth position in the cylinder. The live cartridges in positions two and three have dented primers indicating misfires. This information indicates that the trigger of the firearm was pulled a minimum of three times, resulting in only a single bullet being fired. Figure 14.3 is a form that may be useful in documenting firearms.

TECHNIQUE FOR CASTING THE BARREL WITH FORENSIC SIL OR ACCUTRANS

Properly assemble the Forensic Sil or AccuTrans mixing apparatus (Figure 14.4a). Carefully insert the mixing tip into

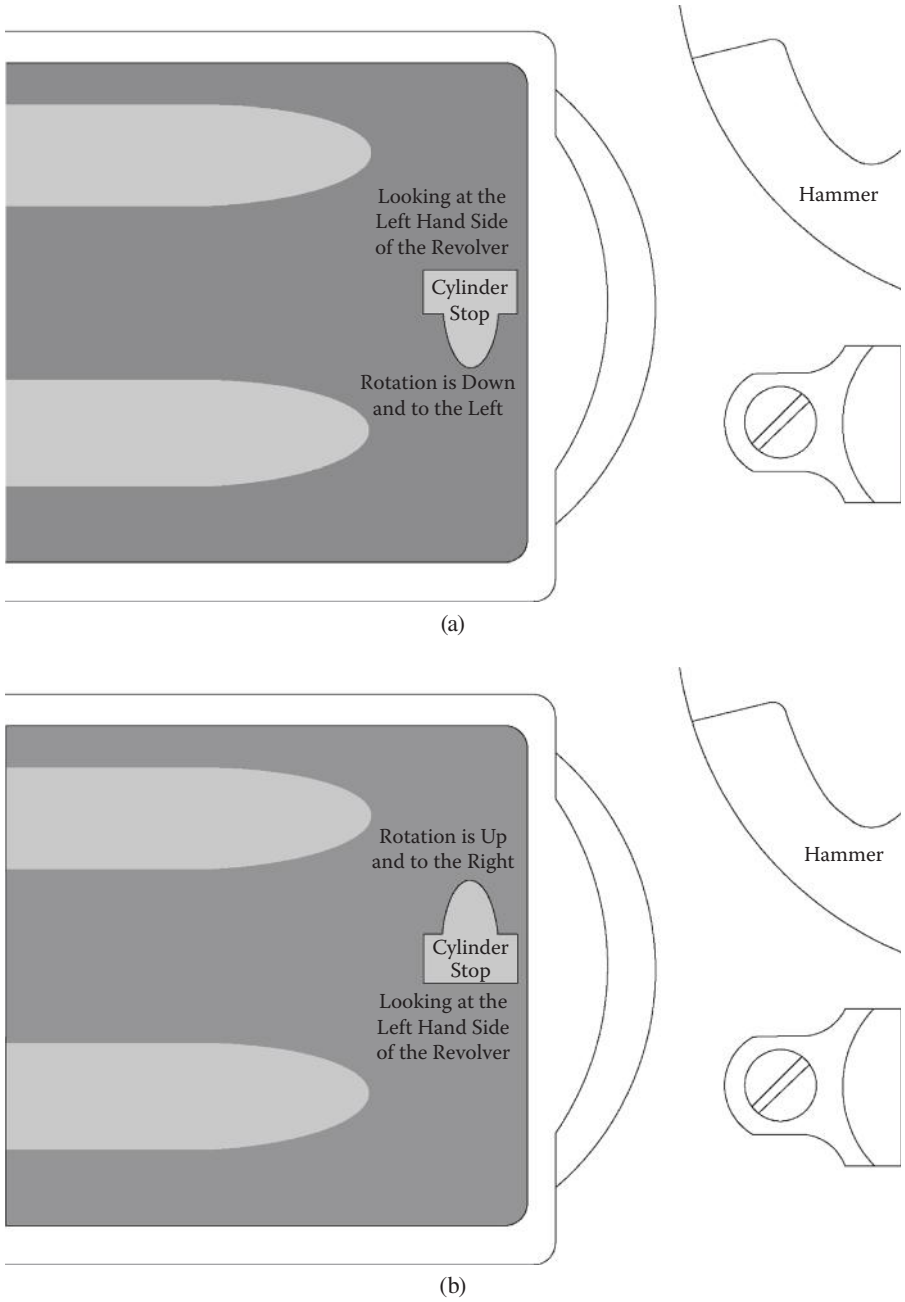


FIGURE 14.1 Images demonstrating how to examine the notch on the cylinder to determine which direction the cylinder rotates.

the barrel of the firearm (Figure 14.4b). Inject the casting medium into the barrel, allowing some of the casting material to exit the opposite end of the barrel (Figure 14.4c). As the casting material fills the barrel, slowly remove the tip while continuing to add casting material.

Allow a small bead of casting material to form on the outside of the barrel. This bead will ultimately be used to pull the dried casting material from the barrel. This procedure is done to prevent any air bubbles from forming inside the barrel. Allow the material to dry. Once the material has dried, carefully cut the muzzle-end bead of casting material (Figure 14.5a) and pull out the material from inside the barrel (Figures 14.5b and 14.5c). The casting material can easily be pulled from the chamber end of the barrel.

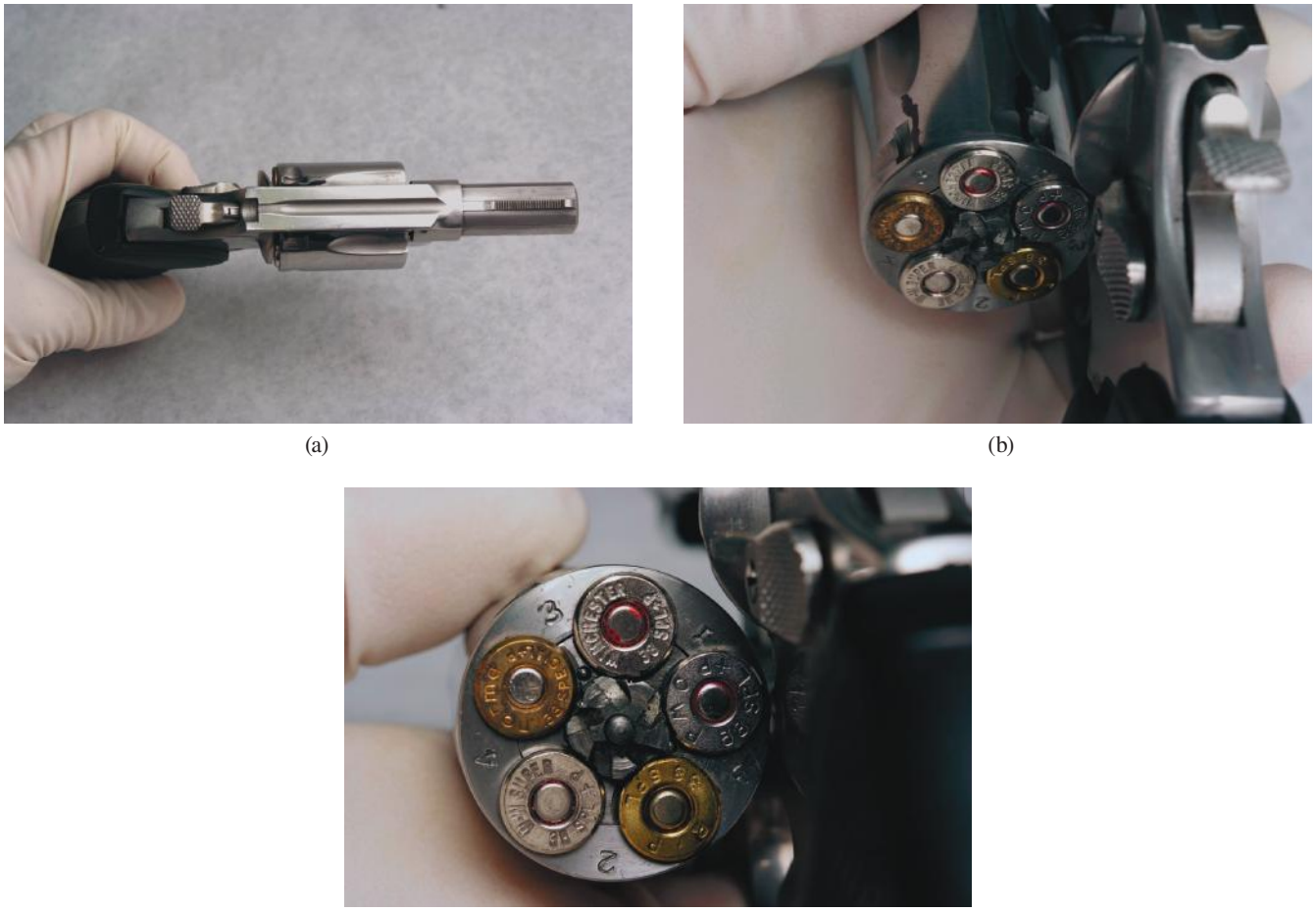


FIGURE 14.2 Images demonstrating the method to mark a cylinder prior to opening it in order to properly document the fired cartridge casings and/or cartridges in the cylinder.

Firearms Identification Form

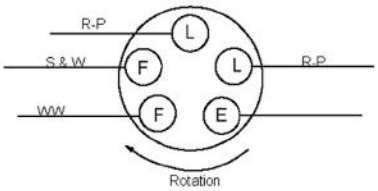
Case / Incident No.:	Crime / Incident:	Location of Crime / Incident:		Date of Collection:
Officer Collecting Firearm & Comm. / Badge / ID No.:		Agency:	State:	County:

Firearms Information:

Make:	Model:	Serial No.:	Barrel Length:	Overall Length:	Caliber:	Country of Origin:

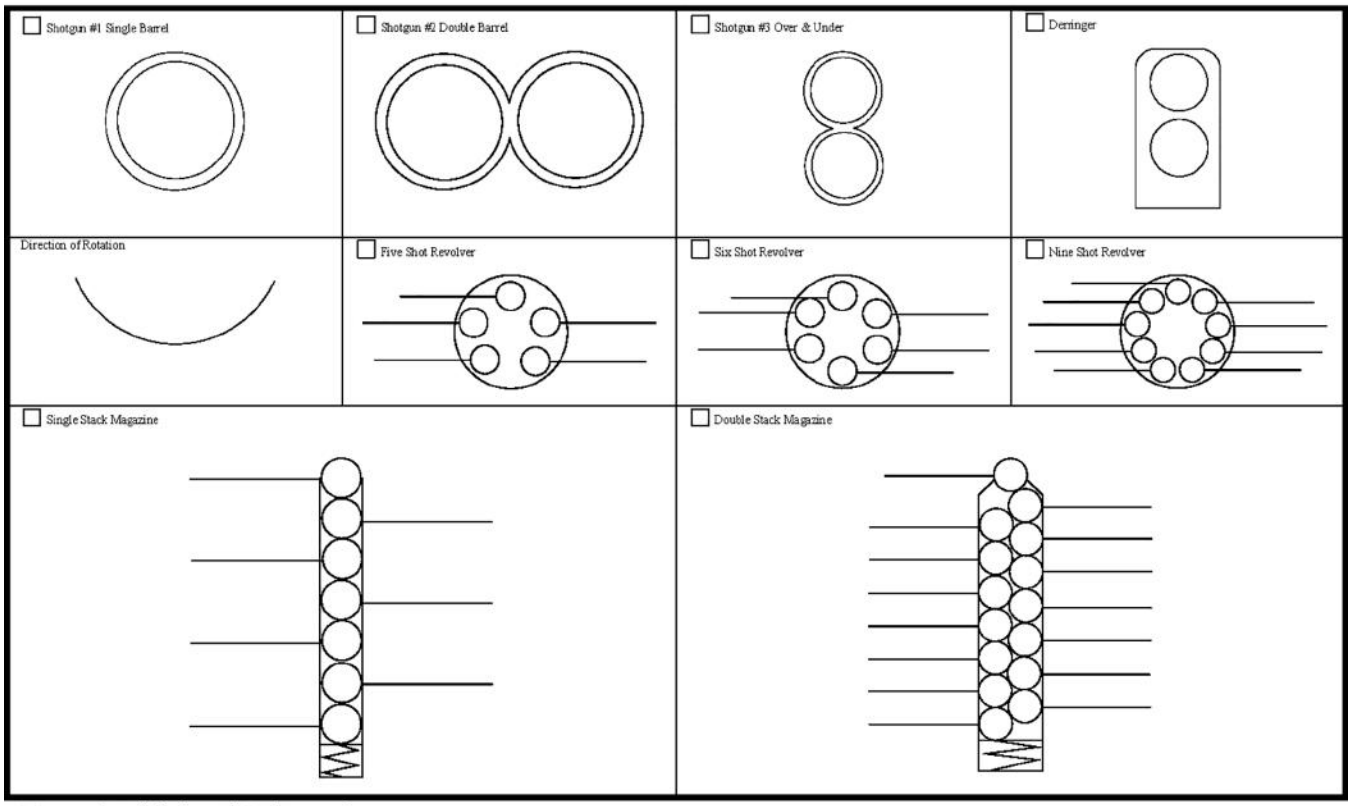
☐ Auto	☐ Semi- Auto	☐ Revolver	☐ Rifle	☐ Shotgun	☐ Blue	☐ Chrome	Hammer Position:	☐ N/A	☐ Un-cocked	☐ Half Cocked	☐ Full Cock

Instructions:



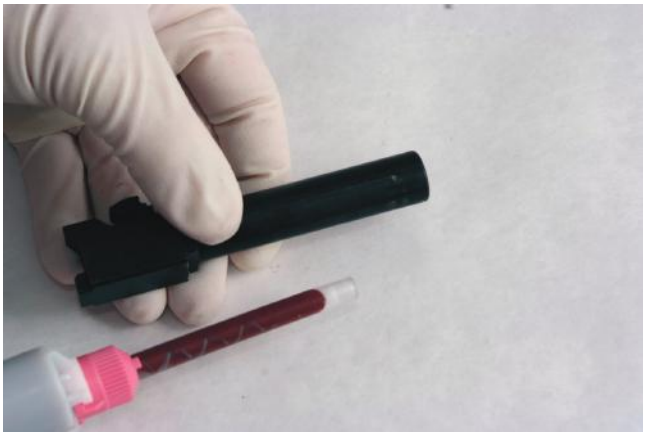
To show where cartridges were found in the firearm, place the appropriate letter and cartridge on the drawing, which are provided below.
Where a live round is found, use the letter "F".
Where a fired round is found, use the letter "F".
Where the chamber is empty, use the letter "E".
Indicate the type or brand of cartridge found by placing the brand mark on the line where the cartridge was found.
NOTE: BE SURE TO MARK THE DIRECTION OF CYLINDER ROTATION

Choke:	☐ Full	☐ Modified	☐ Open	Ammunition Brand:	Ammunition Length:	Shot Size:



Notes / Additional Information:

FIGURE 14.3 This form may be useful in documenting firearms.



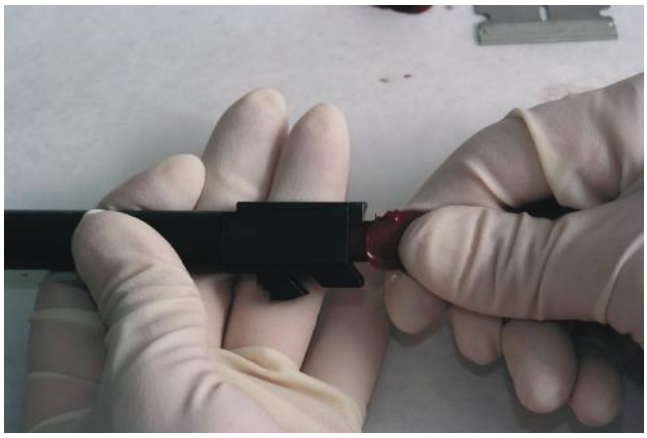
(a)

(b)

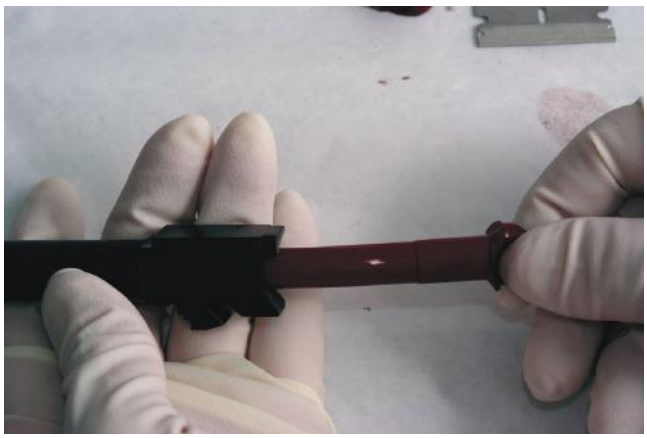
(c)

FIGURE 14.4 Images demonstrate the proper method of placing the Forensic Sil casting medium in the firearm barrel.

(a)



(b)



(c)

FIGURE 14.5 Images demonstrate the proper method of removing the Forensic Sil casting medium from the firearm barrel.

EXERCISE 14.1

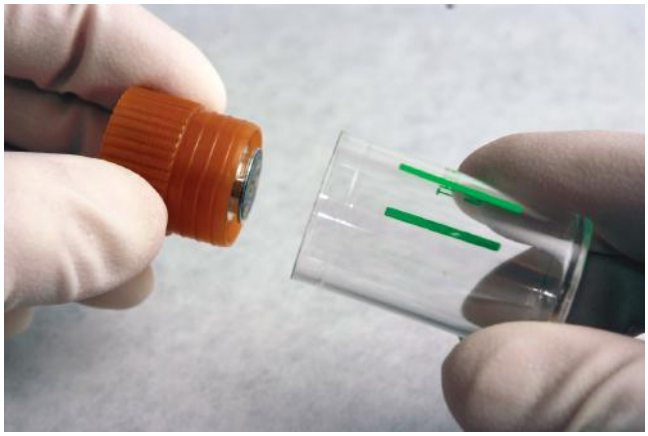
The students will cast a firearm barrel using Forensic Sil or AccuTrans.

Discussion:
Examine the interior of the barrel that was cast. Compare the characteristics in the impression to the characteristics of the particular barrel

THE GUNSHOT RESIDUE (GSR) KIT

Verify that the package is unopened. The adhesive side of the stub is repeatedly depressed on the surface, taking care not to rub the adhesive material over the surface (Figure 14.6a). The cover supplied with the stub is generally labeled. If the stub is used on an area different from what is marked on the cover, make sure you mark through the label and write the correct location where the stub applied. An example of this might occur when a car seat is stubbed. The kits generally contain an instruction page that suggests where to apply the stub. These instructions are good when being applied to the suggested areas. Replace the cover over the adhesive end of the stub (Figure 14.6b and 14.6c). Return the unit to the original GSR kit.

(a)



(b)

(c)

FIGURE 14.6 Images demonstrate the proper technique to stub a surface to collect GSR.

TOOLMARKS

Rubber Casting

These are compounds that must be prepared prior to casting the surface. There are several commercially available products.

Durocast™ Technique

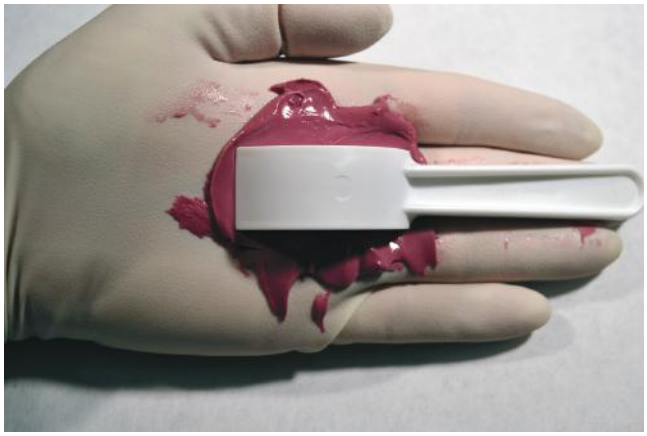
This is a silicon casting material that is very sensitive. The kit generally comes with a container of puttylike material, a catalyst, and a plastic scoop (Figure 14.7). Use the scoop to measure out a level scoopful of the puttylike base material. Place the base material into the palm of your hand (Figure 14.8a). Use the bottom side of the scoop to flatten out the base material in your palm. Turn the scoop over and make an impression of the scoop in the base material (Figure 14.8b,c).

Squeeze a line of the catalyst along the length of the impression of the scoop (Figure 14.9a). Mix the base material and the catalyst together using your hand until there is a uniform color; however, do not exceed 30 s of mixing time (Figure 14.9b). If the mixing time is too long, the casting material will set up and it will be of no use to you after that. The casting material will lose it tackiness and will take on a rubbery texture. Due to the quick time the casting medium sets up, it is also advisable to mix the casting medium near the area where it will be used to cast the impression. If the impression is a good distance from you when you begin mixing the casting medium, it may set up before you reach the impression.

Press the compound over the impression site (Figure 14.9c). It will take approximately 8–12 min for the compound to completely dry before removing the cast from the impression. This procedure will cover an area approximately 1.5 × 3 in. The procedure described here may be repeated for larger areas. A release agent is generally not necessary for most surfaces.

FIGURE 14.7 Image of a Duracast kit's contents.

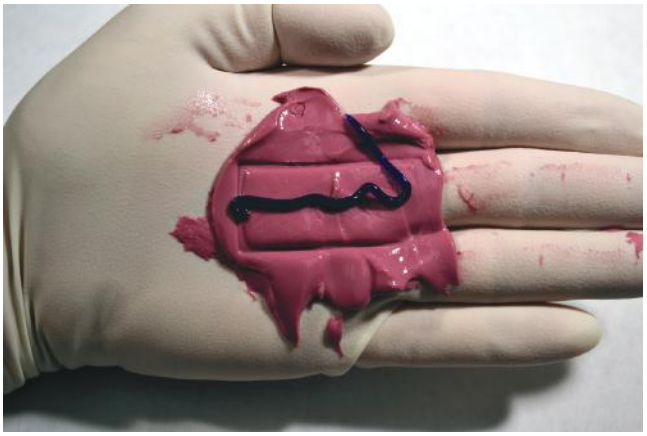
(a)



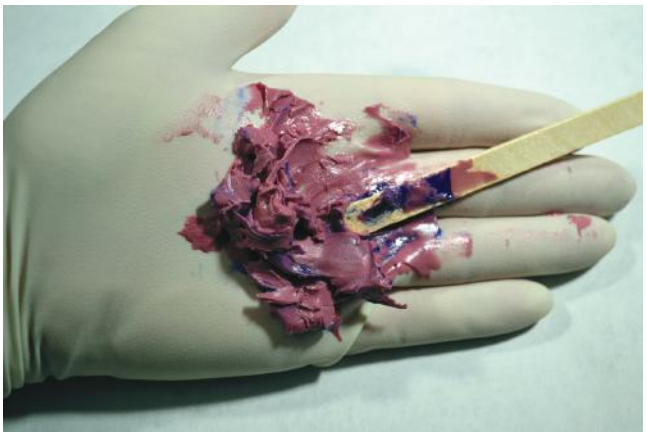
(b)

(c)

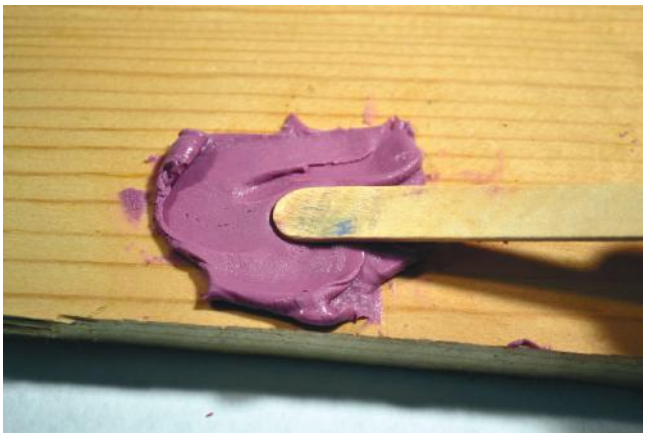
FIGURE 14.8 Images demonstrate the proper technique to prepare the Duracast material.



(a)



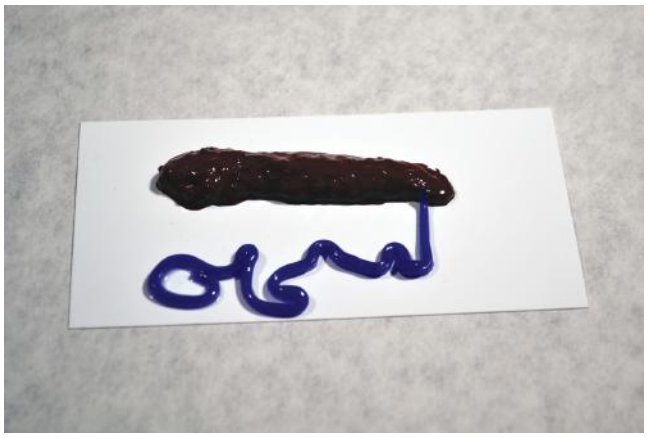
(b)



(c)

FIGURE 14.9 Images demonstrate the addition of the hardener, mixing the casting medium, and applying the casting medium to the surface containing the impression.

FIGURE 14.10 Image of a Mikrosil kit's contents.



(a)

(b)

FIGURE 14.11 Images demonstrate the proper technique to mix and apply the Mikrosil casting medium to a surface containing an impression. *(continued)*

Mikrosil™ Technique

There is a large tube of base compound, a smaller tube of hardener, several white cards, and several stir sticks (Figure 14.10). Approximately 1.5–2 in. of the base compound is squeezed out onto one of the white cards (Figure 14.11a). A shorter strip of hardener is squeezed out next to the base material. Use one of the wooden stir sticks and mix the base and the hardener together until the blue hardener is completely absorbed by the base (Figure 14.11b). This should take approximately 20–30 s. If you mix longer than about 30 s, the compound may set up too quickly.

(c)

FIGURE 14.11 (continued) Images demonstrate the proper technique to mix and apply the Mikrosil casting medium to a surface containing an impression.

The mixed casting material may be applied to the impression by pressing the material on the white card onto the toolmark or by using the wooden stir stick (Figure 14.11c). The casting material is allowed approximately 10 min to set up before it is removed from the toolmark. Once the casting material has had ample time to properly set up, carefully peel the material away from the toolmark.

Forensic Sil/AccuTrans Technique

There is an applicator gun, mixing tips, and tubes of preloaded compound that comes in commercially available kits (Figure 14.12). There is an optional wide-spreading tip, which is sold separately from the main kit. A popsicle stick may be used in place of the wide-spreading tip, but it must be used quickly due to the fact that the casting material sets up very quickly.

The 75-ml double cartridge is inserted into the applicator gun. The mixing tip is then attached to the end of the 75-ml double cartridge. Place the tip over the area the compound will be extracted onto (Figure 14.13a). The trigger is squeezed, forcing the compounds out of their cartridges. The special mixing tips properly mix the two compounds.

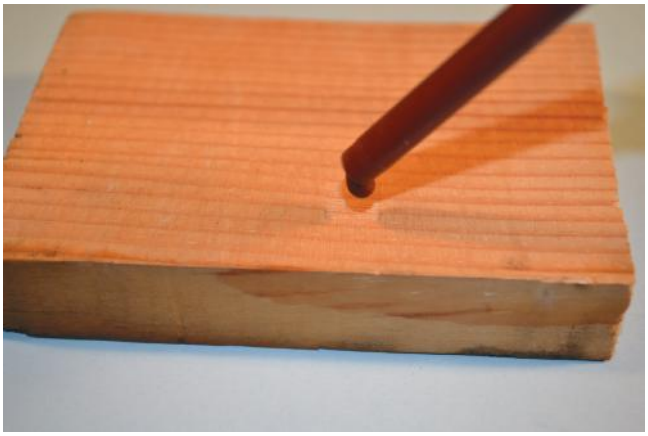
Tip: When using the transparent compound, keep the mixing tip in the compound as it is being extracted from the cartridges to avoid air bubbles (see Figure 14.13b).

When using the brown or white compounds, use the tip to stir the compound as it is extracted onto the surface. This will help in removing any trapped air bubbles from the compound. The trapped air bubbles are primarily due to the higher viscosity of the colored compounds as compared to the transparent compound.

(a)

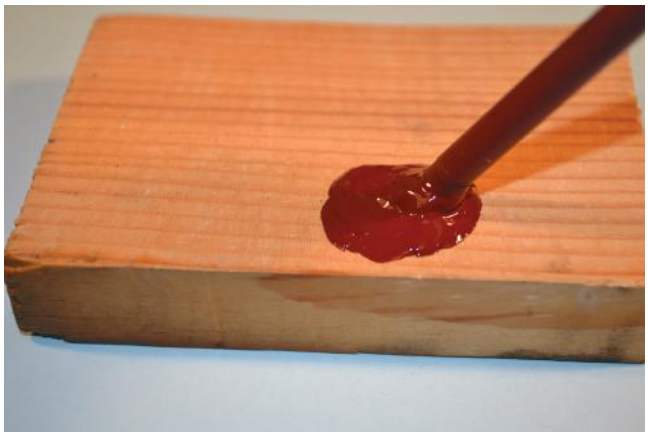
(b)

FIGURE 14.12 Images of a Forensic Sil casting kit and its contents.



(a)

FIGURE 14.13 Images demonstrate the proper technique to mix the Forensic Sil/AccuTrans casting medium. *(continued)*



(b)

(c)

FIGURE 14.13 (continued) Images demonstrate the proper technique to mix the Forensic Sil/AccuTrans casting medium.

EXERCISE 14.2

The students will place different types of toolmarks on a surface. As an alternative, the student may cast coins and other materials with similar types of small details.
The student will properly photograph the toolmarks using the worksheets in Photo Exercise 4.21.
The student will then cast a toolmark using multiple casting methods.

Discussion:
The students will examine and compare the cast toolmark to the toolmark impression on the surface.

Casting Method:

Casting Method:

Casting Method:

Casting Method:

PHOTO EXERCISE 4.21

Toolmark Impressions

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Place the camera on a tripod.
2. Adjust the camera to aperture priority mode.
3. Set the aperture to f/11.
4. Position the camera over the toolmark impression so that the impression is positioned in a landscape format.
5. Be sure to use the appropriate scale and scale placement when photographing.

Toolmark Evidence:

1. Photograph a toolmark piece of evidence using side lighting.
2. Photograph same toolmark piece of evidence with lighting at 30° angle to object.
3. Photograph same toolmark piece of evidence with lighting at 45° angle to object.
4. Photograph same toolmark piece of evidence with lighting at 60° angle to object.
5. Photograph tool that made the mark with side lighting.
6. Photograph tool that made the mark with lighting at 30° angle to object.
7. Photograph tool that made the mark with lighting at 45° angle to object.
8. Photograph tool that made the mark with lighting at 60° angle to object.

15 Exercises for Footwear and Tire Track Impression Evidence

INTRODUCTION

When we consider a person's movement from one place to another or even from room to room, unless he or she has the ability to fly, people will generally move by walking. When people walk, they leave some form of footwear impressions on the surface as people walk. When a person commits a crime, he is also leaving footwear impressions on the surface. The perpetrator must get to the crime, commit the crime, and then leave the scene in some manner. He may take several modes of transportation to get to the scene, such as a car, bus, bicycle, etc. However, once he arrives at the scene, in almost all cases, he must then walk to the area where the crime is actually committed, commit the crime, and then leave the scene.

By understanding this interaction between the footwear and the surface, there is often the potential of obtaining impression evidence every time a person takes a step. However, this type of evidence is potentially the least sought after of all the evidence. This type of evidence must also be searched for and recovered by a crime scene investigator. Footwear examinations may also be useful in identifying what types of footwear were used during the commission of the crime. The examiner may also be able to link specific footwear to specific footwear impressions. Footwear impressions are also valuable in determining the actions of the suspect or suspects as well as the victims while in the scene. The lack of footwear evidence in a scene is just as vital in determining whether or not a crime/incident actually occurred.

USEFULNESS OF FOOTWEAR IMPRESSIONS

How are footwear impressions useful to the investigation? What information might be obtained from the footwear impression? These are valid questions to the untrained individual. To a footwear impression analyst, the potential information from such impressions is enormous. Analysts may be able to provide identification of the footwear used. They also may be able to eliminate footwear as having been the contributor.

It may be possible to determine footwear brand and size as well as the number of perpetrators involved. It may be possible to link specific footwear to an impression. This may provide information that the individual was at or participated in the criminal activity. Impressions may also be useful in linking several crimes together. Impressions located near certain items of evidence may be useful in linking a specific individual to that particular piece of evidence. Footwear impressions may also leave information that indicates where the individual went after leaving the scene, thus bringing up the possibility of tracking the individual.

These types of examinations are only possible *if* the impression evidence is searched for, documented, and recovered. If the evidence is not documented and collected, this examination is obviously impossible. Footwear impression examination may also provide the number of suspects present. This type of evidence—like all other evidence—may also be used to corroborate and/or refute witness, suspect, and victim statements.

Positive and Negative Impressions

A positive impression is created when the footwear deposits dust and/or other materials onto the surface being walked on. That is, the footwear leaves something behind. A negative impression is made when the footwear removes dust and/or other materials as the footwear walks across the surface. That is, footwear takes something away. Impressions may be either two dimensional (2-D) or three dimensional (3-D).

Mirror Technique

Position a mirror on the opposite side of the area you are about to examine for footwear impressions (Figure 15.1a). The mirror is angled backward. The angle is dependent upon the distance between the investigator and the mirror: The farther the investigator is from the mirror, the lower is the backward angle that will be necessary. At approximately 6 ft away, angle the mirror approximately 20° backward; at approximately 12 ft, angle the mirror approximately 10° backward.

Use oblique lighting to illuminate the surface suspected of containing the footwear impressions. The light source should be shined across the surface toward the mirror at approximately a 30° oblique angle. Any footwear impressions on the surface should now be visible in the mirror. It may be necessary to adjust the mirror and/or angle of the light source in relationship to the mirror to better view the footwear impressions.

Utilizing two laser pointers (one green and one red), aim the pointers on the surface containing the impressions, one at the heel and the other at the toe area of the footwear impression (Figure 15.1b). Use the mirror as a guide to properly position the laser pointers. Once the heel and toe of the footwear impressions have been marked, a second investigator may use a gel lifter to lift the footwear impressions using

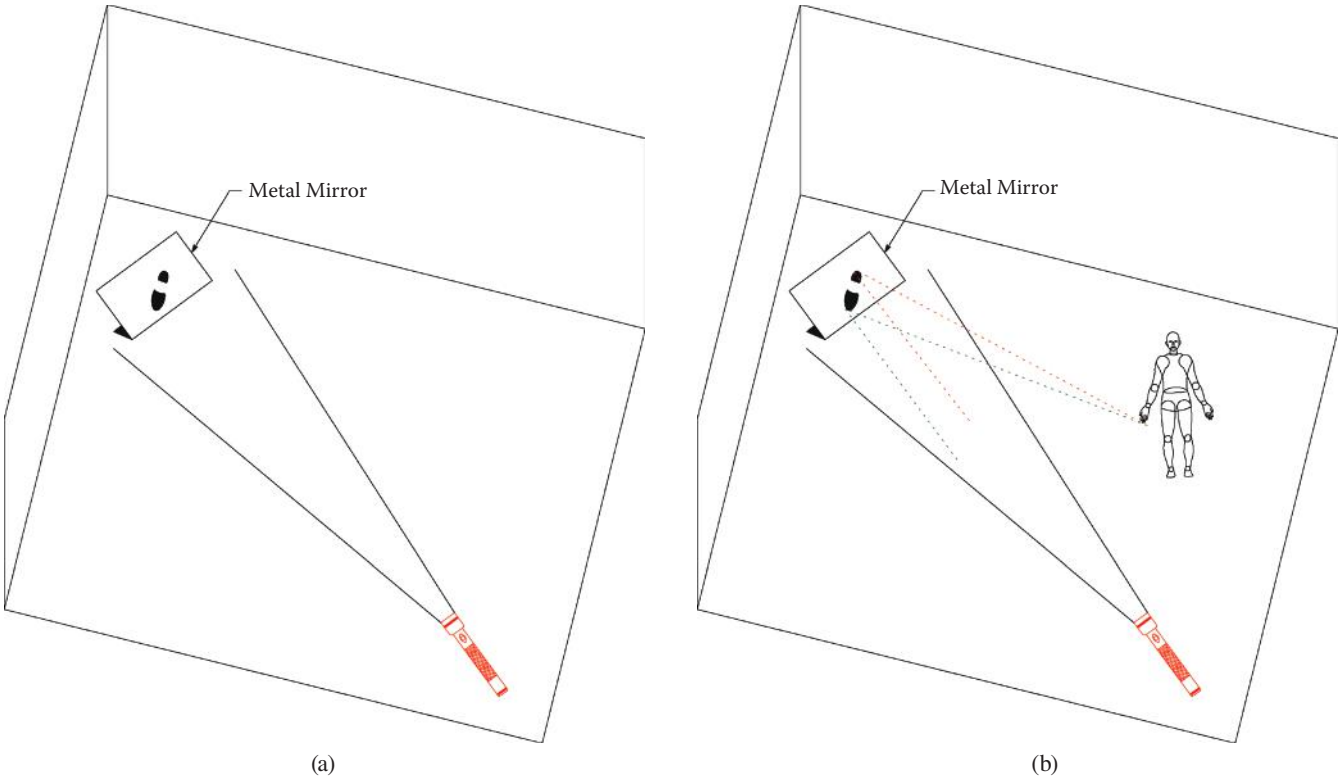


FIGURE 15.1 Illustrations of the mirror technique to locate footwear impressions.

laser pointers and reference marks. Using red- and green-colored laser pointers (as shown in Figure 15.1b) will assist second investigator in locating the heel and toe areas of the footwear impression.

Photographing the Impression

Hold a flashlight or floodlamp at a 10° angle to the impression. Rotate the flashlight around the impression, examining the impression from all sides. Raise the flashlight up to about 20° and repeat the process. Repeat the process a third time at a 30° angle. Repeat the process a final time at a 45° angle. Figure 15.2a illustrates the oblique-angle process for 3-D impressions, while Figure 15.2b illustrates the proper light angle for 2-D impressions.

Adjust the lighting to the angle that gave the best view. Take a series of three (Figure 15.3c) or four photographs (Figures 15.3a and 15.3b), with the light being on three or four different sides. Examine the contrast between the different processes and determine which lighting technique provides the best contrast.

Proper tripod placement is just as important as the lighting techniques. For impressions on level surfaces, setting up the tripod is easy (Figure 15.4a). If the impression is on a sloped surface, it is imperative that the tripod be adjusted so that the camera is properly positioned (Figure 15.4b). The camera's film plane or image-sensor plane must be parallel to the surface containing the impression to avoid any possible distortion.

The use of a golf ball spotter is a convenient method to indicate oblique lighting angles. Recall the discussion about the proper placement of the scale in examination-quality photographs: The scale must be on the same level as the bottom of the impression in soil.

The use of a beveled 1¼-in. putty knife was very helpful in trenching out the area for the proper scale placement. Figure 15.5 shows images demonstrating the proper lighting angles to document footwear impressions.

If you choose to use a product such as autobody primer or Snow Print Wax™ on the impressions, the impression must be appropriately photographed. Again, one may ask, "Is it truly necessary to photograph each step if you plan to cast the impression?" The answer is *yes*. This is because of the potential of damaging the impression during the casting process. If the impressions are damaged, the photographs will serve as the backup. Figure 15.6 shows images demonstrating the proper lighting angles to document footwear impressions in sand using Snow Print Wax to provide contrast to the footwear impression.

Impressions in Direct Sunlight May Be Shaded from the Direct Sunlight

Use an object to cover the tripod, such as a towel, blanket, or coat. If it is windy, have someone hold the object to block the sun to prevent movement of the tripod.

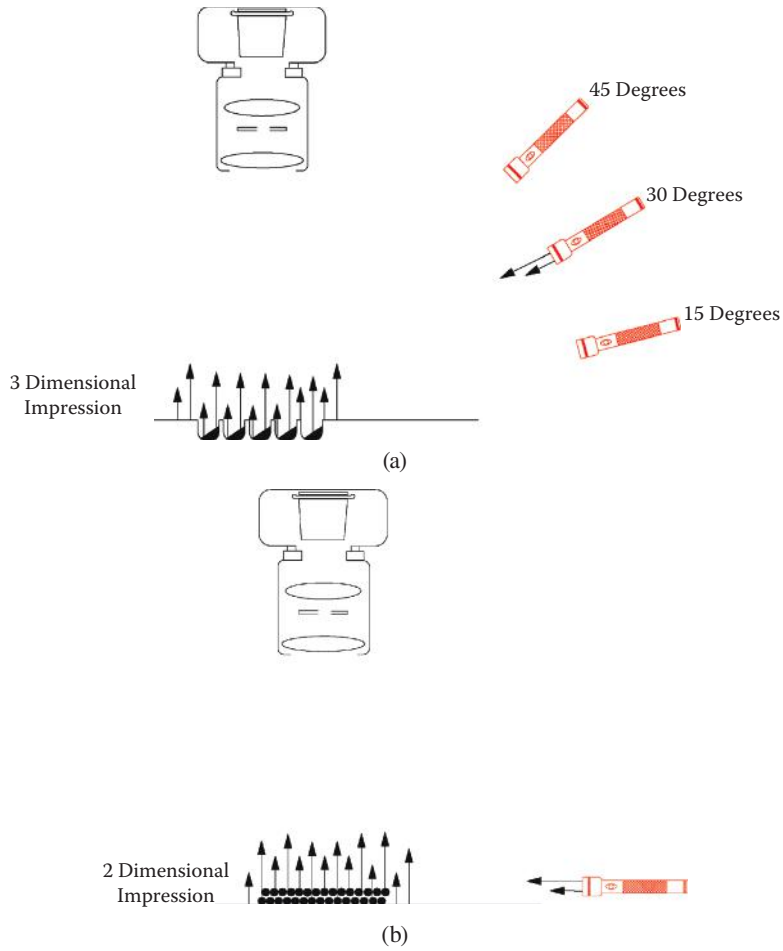


FIGURE 15.2 Illustrations demonstrate the appropriate lighting techniques for 2-D and 3-D impressions.

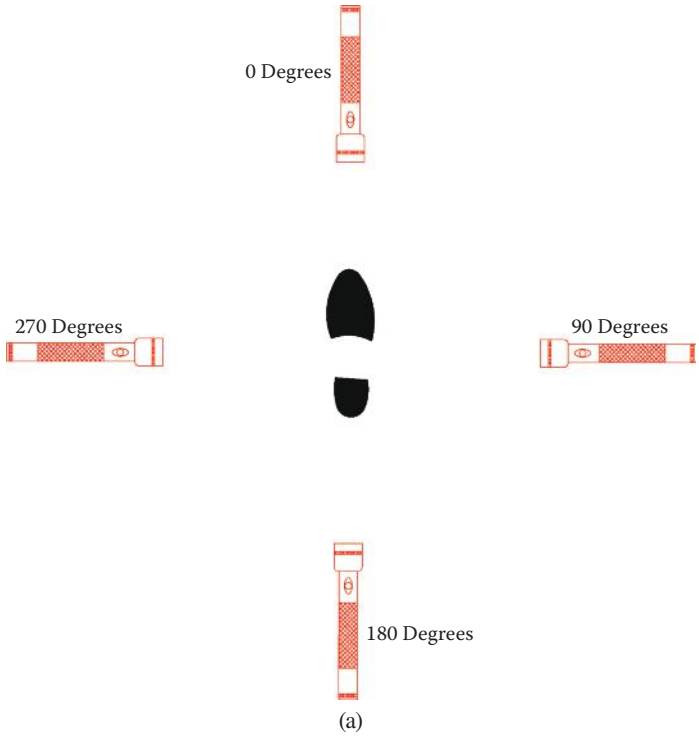


FIGURE 15.3 Illustrations of the proper placement of the light source to properly photograph footwear impressions. *(continued)*

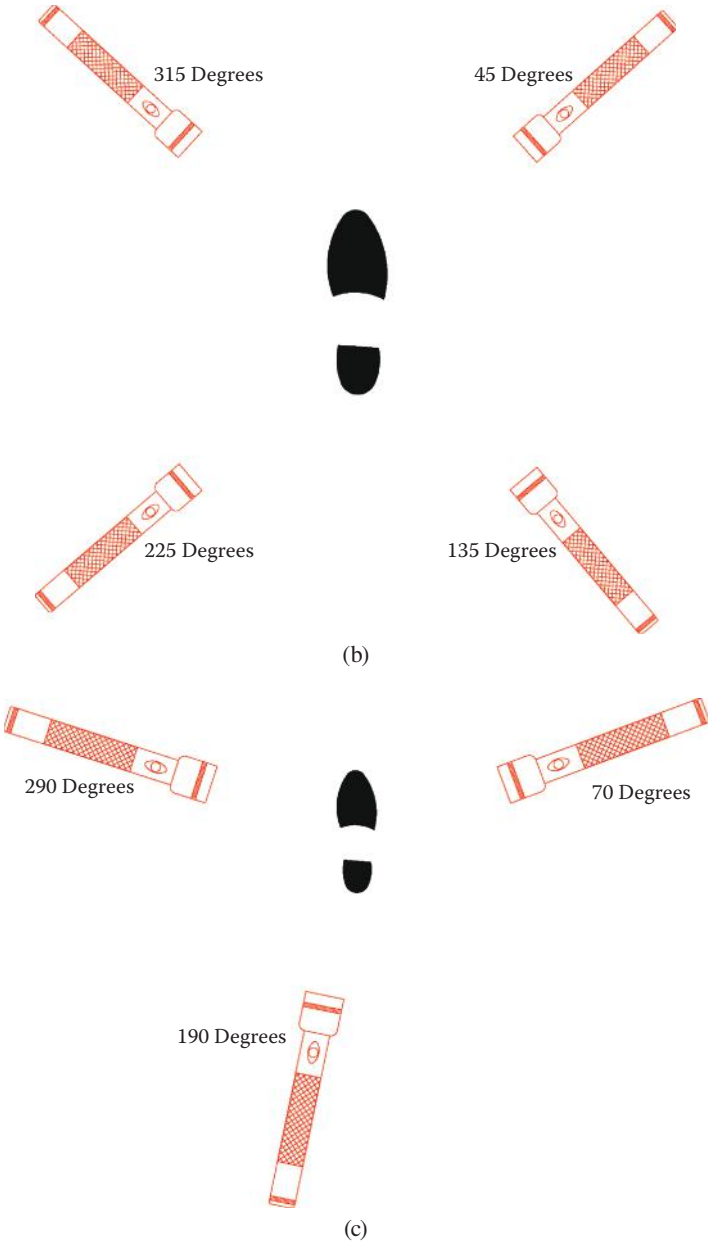


FIGURE 15.3 (continued) Illustrations of the proper placement of the light source to properly photograph footwear impressions.

Photographing the Cast, Electrostatic Lifter, or Gel Lifter

Proper examination-quality photographs of the cast should also be taken. These photographs are used as a backup to a cast that may become damaged. Any casts and electrostatic lifts should have proper examination-quality photographs taken. Casts should never be cleaned prior to photographing; this is done by the analyst. Gel lifters should be photographed, since the gel will absorb the enhancement materials, such as latent fingerprint powder, etc.

When documenting footwear impression, certain measurements may be helpful in providing additional information from a footwear-impression analyst. Figures 15.7 and 15.23 illustrate the additional measurements necessary to properly document footwear impressions. Some of these measurements may be useful in eliminating an individual as a potential suspect simply on the measurements of the footwear tracks left by the individual.

Stabilizing the Impression

If the impression is in soft, loose soil, it may be necessary to stabilize it. Clear lacquer or hair spray works well to stabilize impressions in sandy soil. Gray autobody primer works well to highlight impressions in snow. Snow Print Wax yields a good cast but provides poor contrast in photographs.

Whatever stabilizing method you choose to use, be cautious and do not hold the material close to the impression and spray the stabilizing material directly into the impression (Figure 15.8a). By spraying directly into the impression,

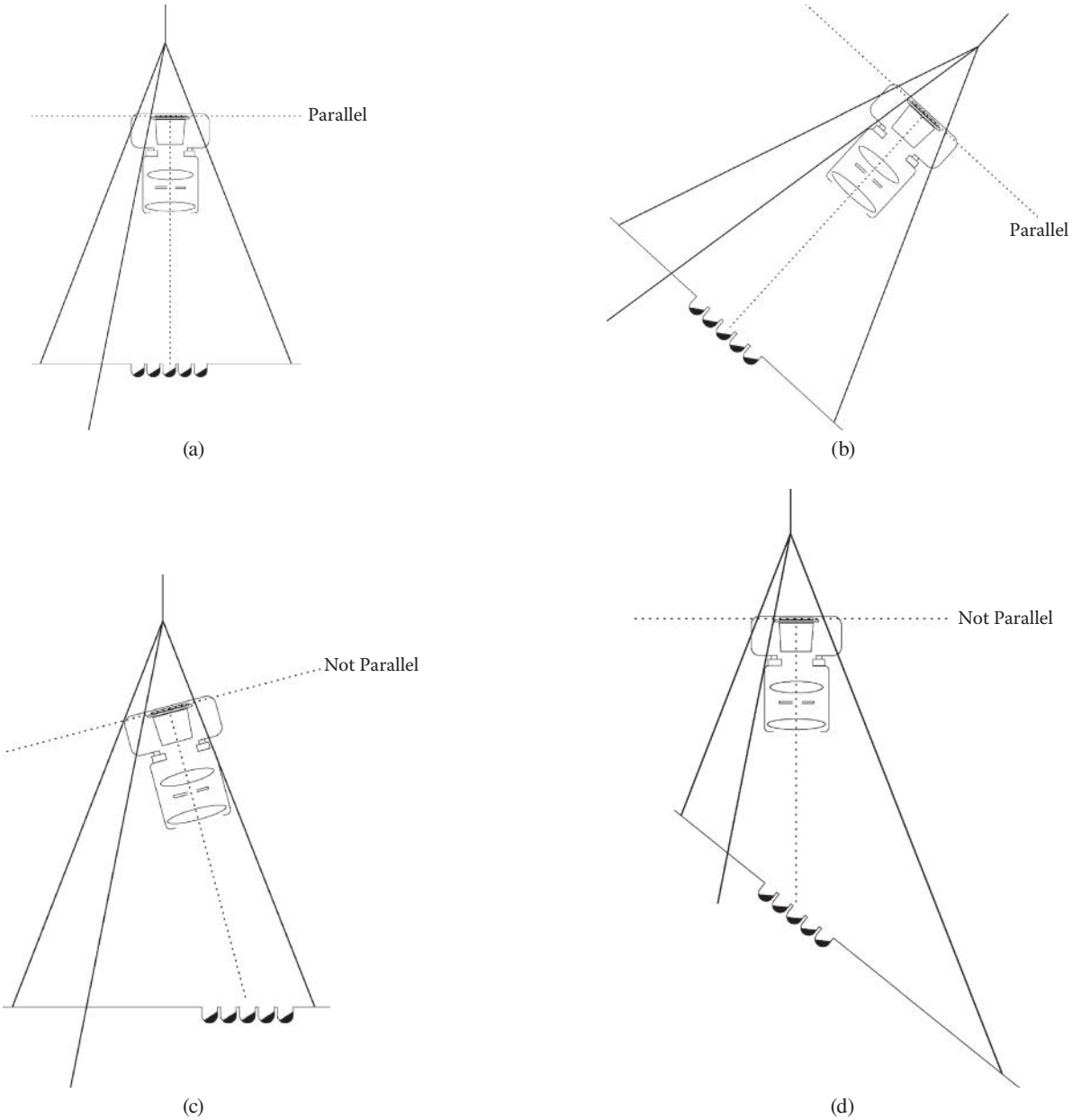


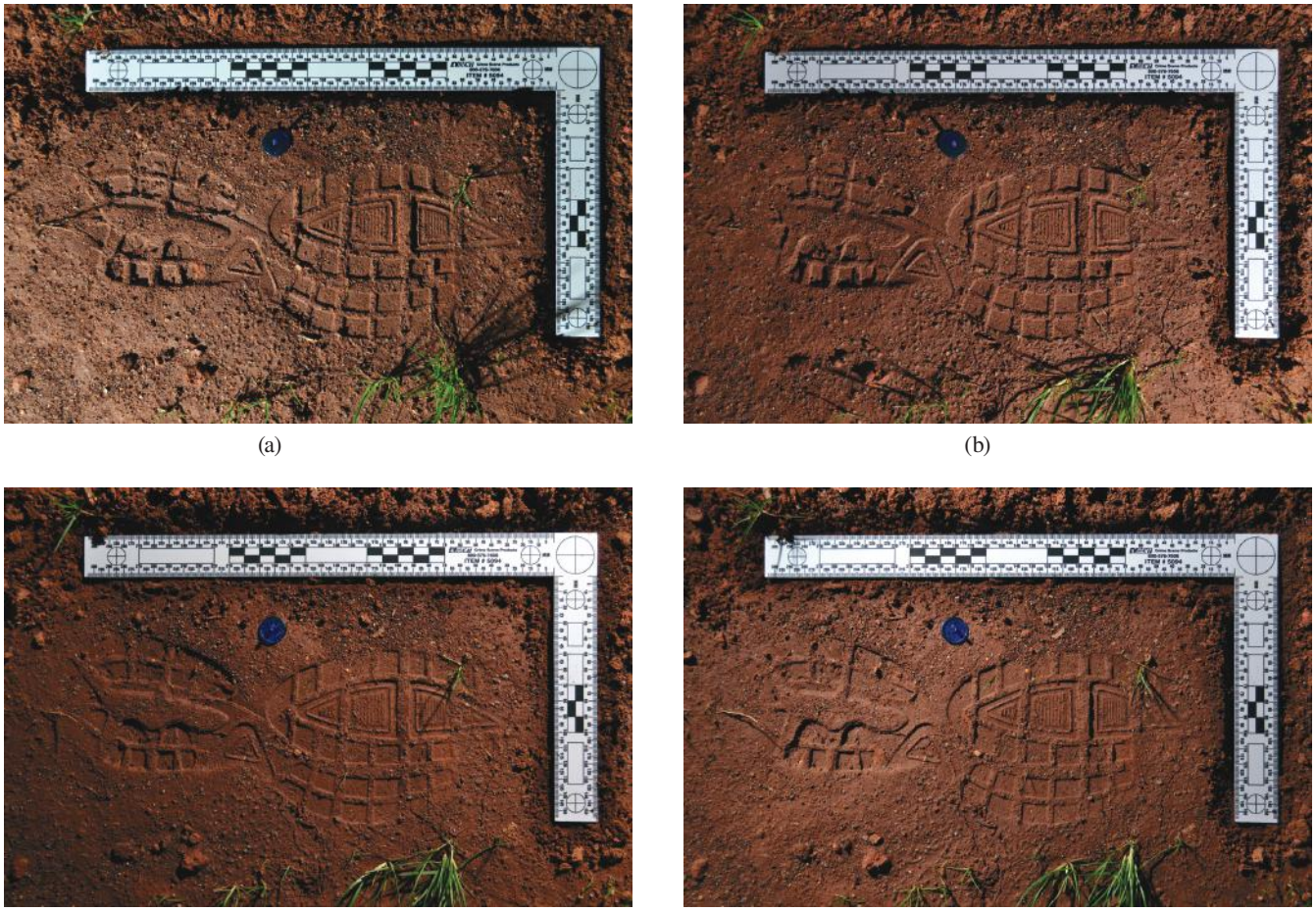
FIGURE 15.4 Illustrations of the proper and improper placement of the tripod on level and sloped surfaces.

the force of the aerosol being propelled from the can may disturb the actual impression (Figure 15.8c). By spraying the lacquer onto an index card and allowing the mist to fall on the impression, you avoid disturbing the detail in the impression. However, be cautious with this technique so that you are not dripping the stabilizing liquid onto the footwear impression, as the large drops will damage the footwear impression.

Another technique is to hold the nozzle of the can parallel to the surface of the impression. Hold the can approximately 12–18 in. above the surface (Figure 15.8b). Spray the aerosol so that the mist from the can falls onto the impression. Another acceptable technique would be to directly spray the impression, provided that the container is held high enough where the propellant will not damage the impression. Three layers of spray may be necessary to properly stabilize the impression. I suggest that you experiment with nearby soil to ensure that your technique does not disturb the impression. It is also recommended that several applications be sprayed on the impression from different angles. Allow time for the stabilizer to dry between applications.

Stabilizing with Hair Spray

As you spray the stabilizer on the footwear impression, make sure that you spray the impression from multiple angles. Spraying from a single angle only stabilizes the surface of the impression actually being covered by the mist. Applying the stabilizer from multiple angles ensures that the entire impression is stabilized, as shown in Figure 15.9.



(a) (b) (c) (d)

FIGURE 15.5 Images of a properly photographed footwear impression in soil. Notice the golf ball spotter near the top of the impression, between the impression and the large "L" scale.

Stabilizing/Visualizing with Gray Autobody Primer

The use of the autobody primer works similar to the stabilizer in that it must be applied in multiple directions in order to cover the entire footwear impression. The use of lacquer or hair spray may be used prior to the use of the primer, especially on sand. Figure 15.10 shows images that demonstrate the proper application of gray autobody primer. The autobody primer provides stabilization of the impression as well as contrast for photographing the impression.

Stabilizing/Visualizing with Red Snow Print Wax

The use of the Snow Print Wax works similar to the stabilizer in that it must be applied in multiple directions in order to cover the entire footwear impression. Figure 15.11 presents images that demonstrate the proper application of red Snow Print Wax. This technique provides stabilization to the impression as well as contrast for photographing the impression. This technique also fills in cracks in the bottom of snow impressions. This allows the details of the impression to be cast without including the cracks and crevices in the bottom of the impression.

Preparing the Casting Medium

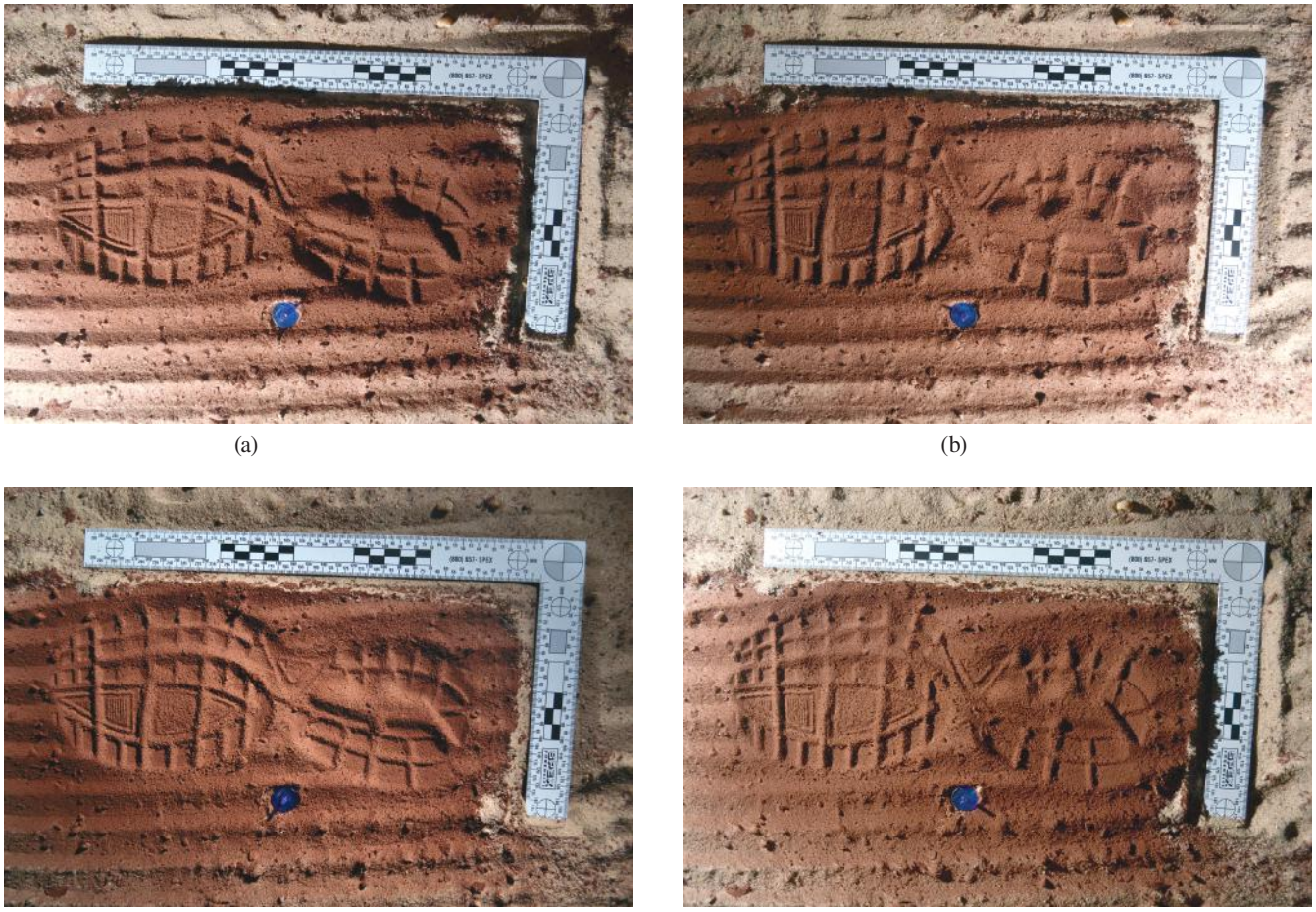
Dental stone is mixed with approximately 4.6 oz water per pound of stone. Two pounds of dental stone generally fill a 10-oz Dixie cup.

Pouring the Casting Mixture into the Impression

Pour the mixture slowly into the impression. It is best to pour the mixture on the area next to the impression and allow the mixture to gradually flow into the impression. Pouring the casting media directly onto the impression will result in damage to the impression. A fingerprint card, index card, or other object can be held near the impression to absorb the direct impact of the mixture before it enters the impression. The casting media is then directed into the impression, allowing the casting media to "flow" into the impression, as shown in Figure 15.12.

Casting on Concrete or Similar Surfaces

Frame the impression with duct tape. Place the tape on the concrete surface as close as possible to the impression. Mix casting media as previously instructed. Pour the medium from side to side. The casting medium should be poured onto the tape;



(a) (b) (c) (d)

FIGURE 15.6 Images demonstrate the proper photographs of a footwear impression in sand that has been stabilized using Snow Print Wax to provide contrast to the footwear impression.

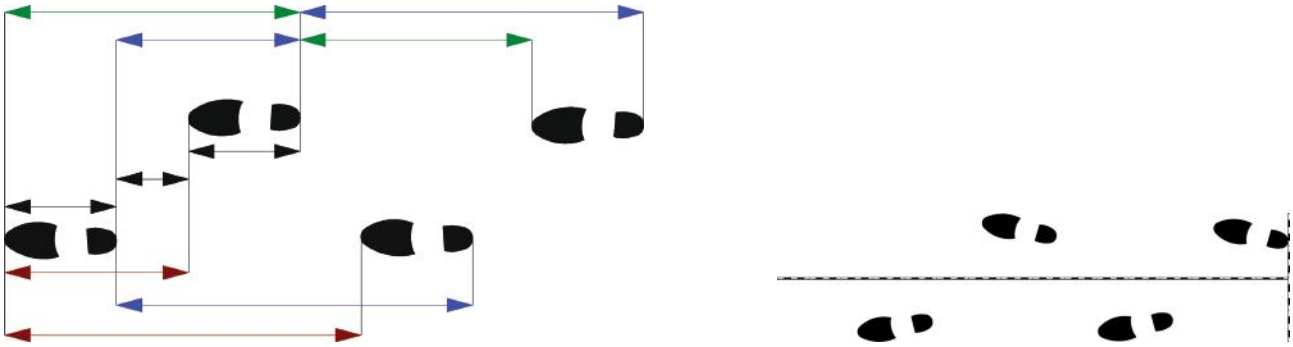


FIGURE 15.7 Illustrations of the additional measurements necessary to properly document footwear impressions.

however, the material should not completely cover the tape. The edges of the tape are to be used to lift the impression once it has properly dried. If the tape is completely covered, then it will be difficult to remove the casting material without damaging the cast. Figure 15.13 shows images that demonstrate the proper method to cast a footwear impression on concrete. The muddy footwear impression shown in Figure 15.13a can be cast using the modified forms (Figure 15.13b).

One area to be aware of while the casting the impression: You need to ensure that the casting medium on the tape is sufficiently thick, preferably as thick as the main cast. If the casting medium is too thin over the tape, the cast will simply break around the edges as the cast is being removed from the surface. This may ultimately result in damage to the detailed area of the cast. At a minimum, the broken edges will make the cast removal from the surface more difficult.

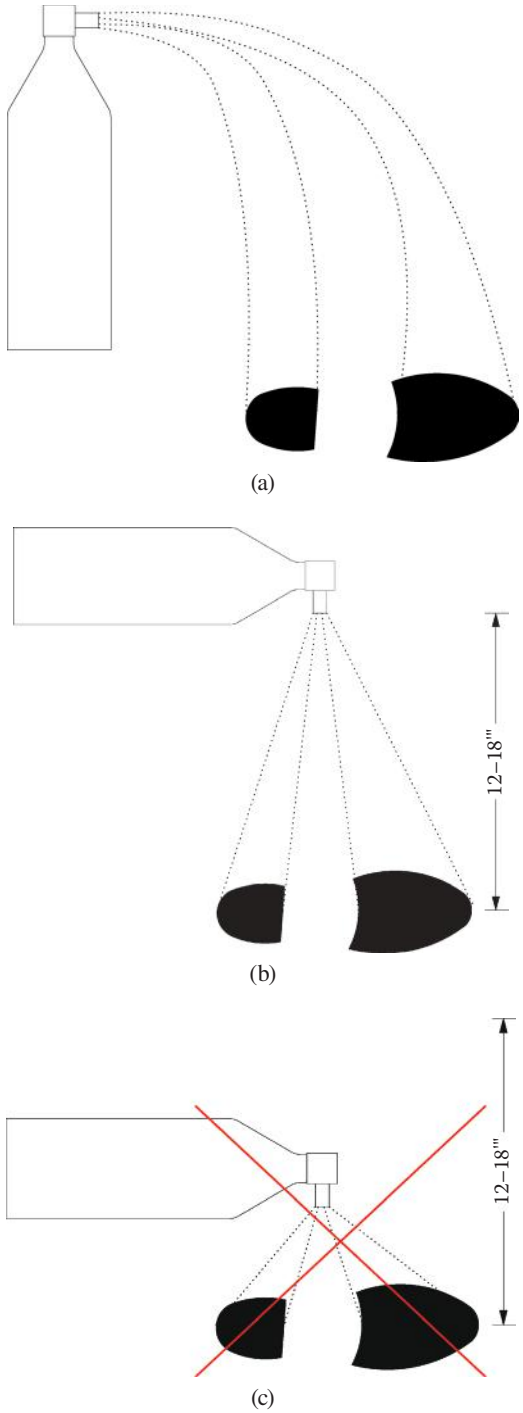


FIGURE 15.8 Illustrations of the proper use of spraying the stabilizer onto the footwear impressions to avoid inadvertently damaging the impression.

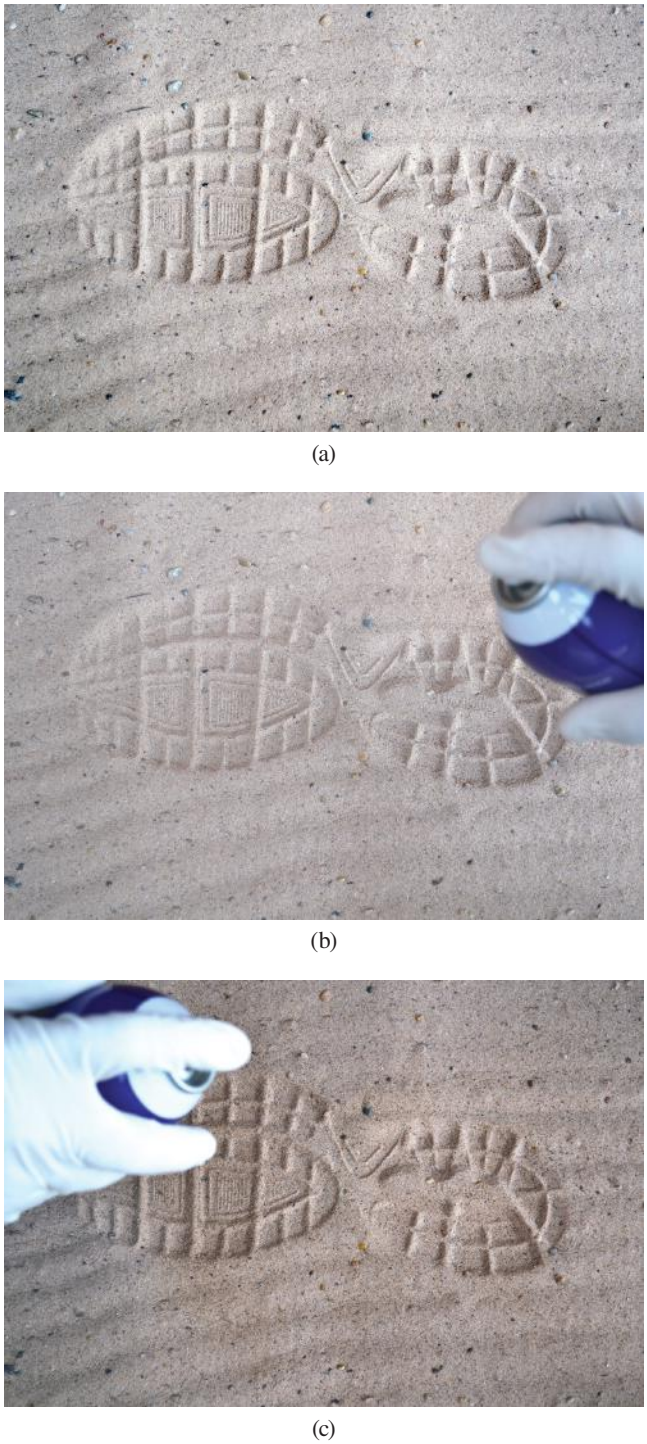
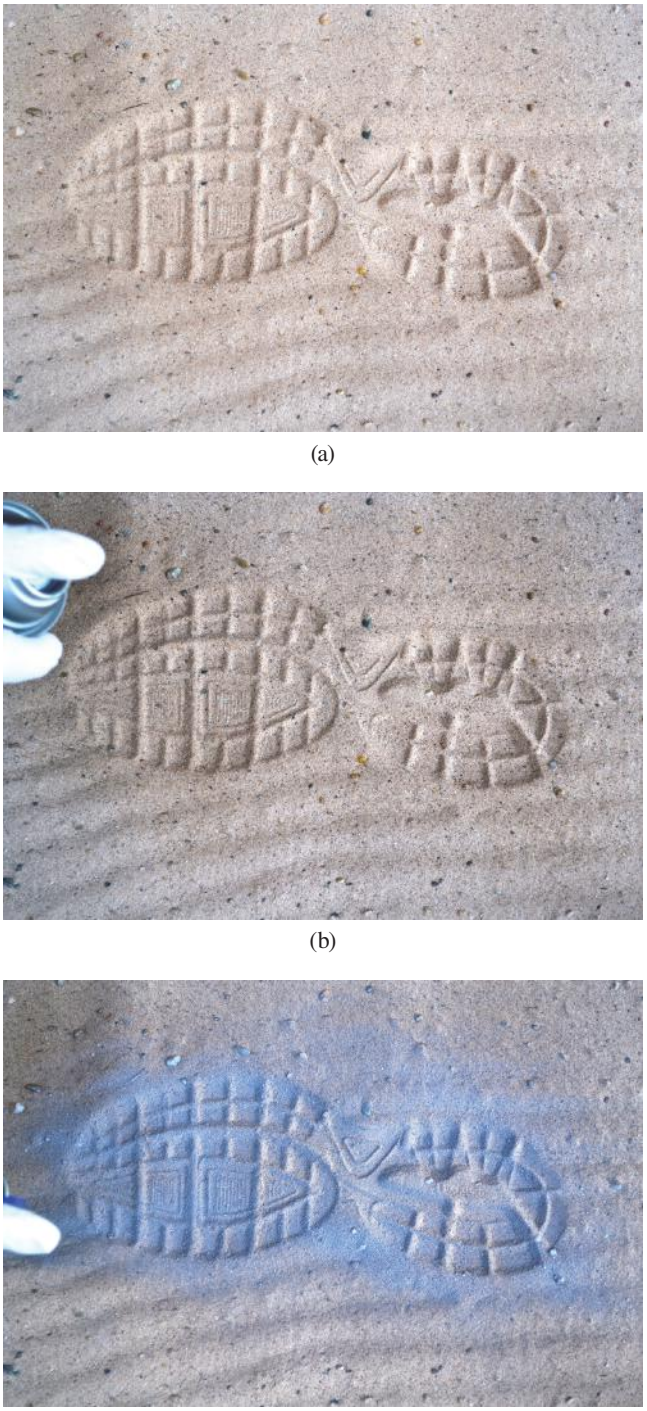


FIGURE 15.9 Images of a footwear impression in sand being stabilized using Aqua Net hair spray.

Casting Impressions Submerged in Water

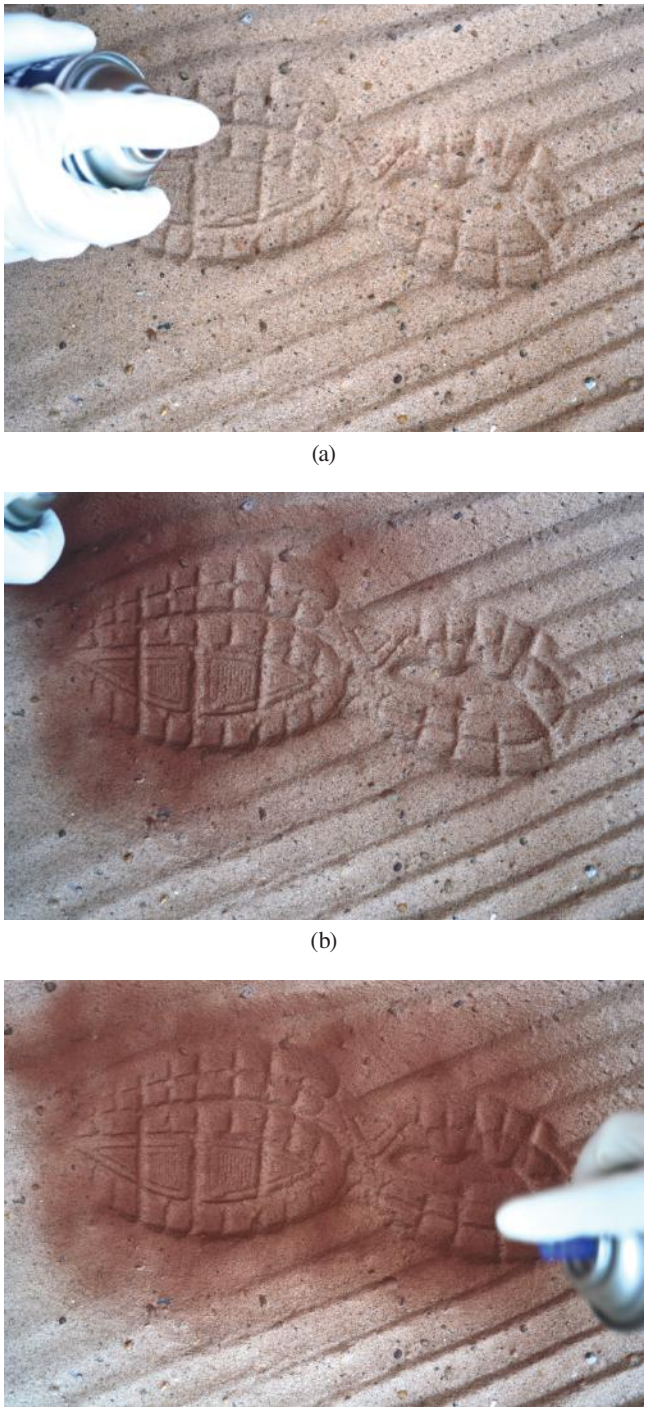
The appropriate method for casting impressions submerged in water requires the use of a modified form. The form must be tall enough to extend out of the water. Otherwise, once the casting material is sifted into the water, it will float downstream. The use of a large poster board is more appropriate for this technique (Figure 15.14b).

The purpose of this form is to keep the casting material in the area of the impression so that the casting material will settle on top of the impression. The poster board may need to be trimmed so that it barely extends out of the water. Poster board is available in several thicknesses. The one shown in Figure 15.14b is among the thinnest of the poster boards available. Utilizing thicker (and slightly more expensive) poster



(a) (b) (c)

FIGURE 15.10 Images of a footwear impression in sand being stabilized using gray autobody primer spray.



(a) (b) (c)

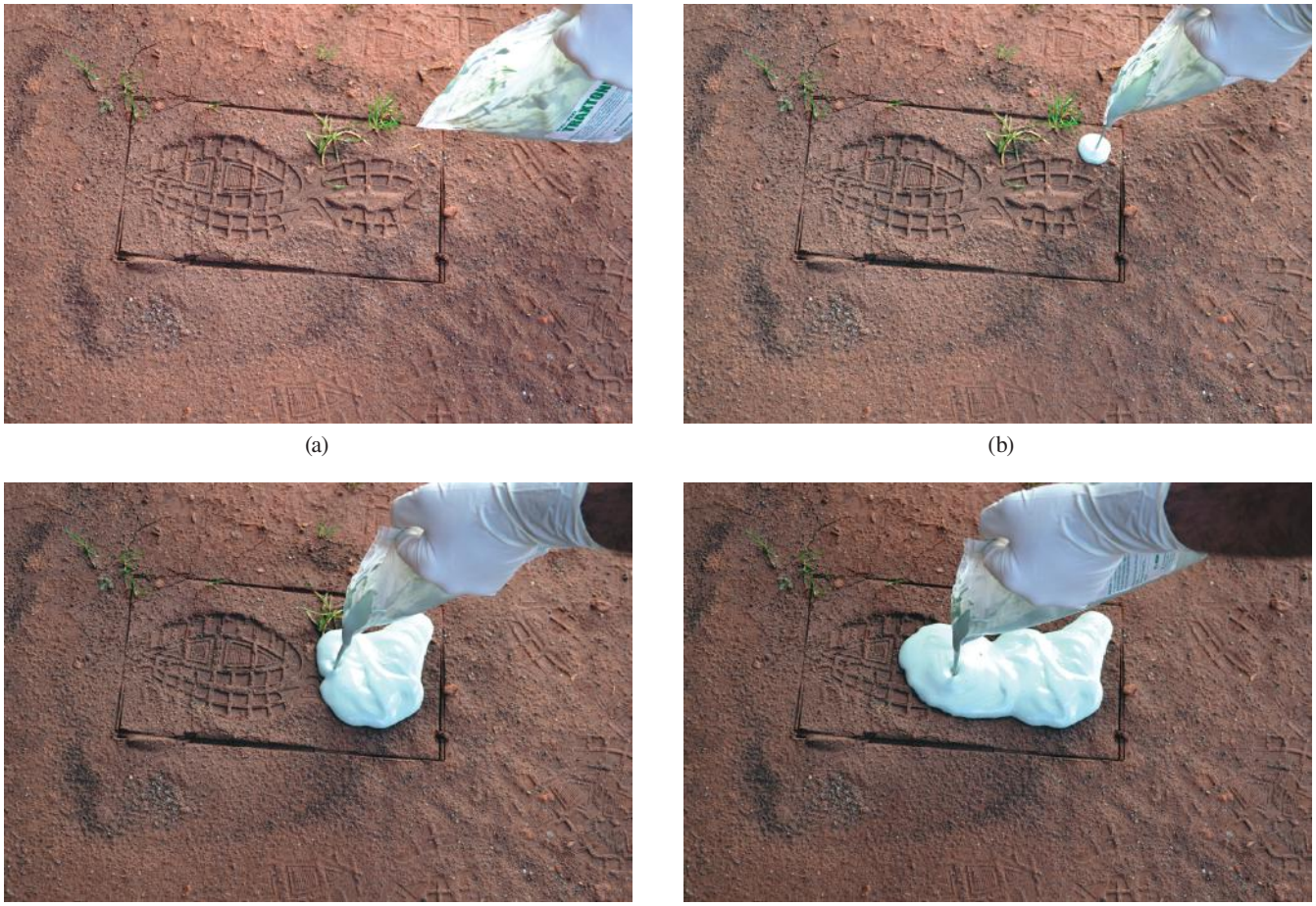
FIGURE 15.11 Images of a footwear impression in sand being stabilized using Snow Print Wax.

boards will allow the paper to remain rigid long enough to cast the footwear impressions.

Carefully position the poster board around the impression, taking care to avoid silting up the impression. Once the poster board is in place, use a flour sifter. Hold the sifter just above the water level and sift the casting material into the water over the impression (Figure 15.15). The casting material will set up even though it is submerged in water, although it will take longer to set up than in air.

Casting Impressions in Snow

Impressions in snow pose some additional obstacles, such as the fact that the casting medium produces heat as it dries (it is an exothermic reaction). One step that may overcome this



(a) (b) (c) (d)

FIGURE 15.12 Images demonstrate the pouring of the casting media into the impression.

obstacle is to add snow to the casting medium mixture as it is being prepared. The snow will not completely eliminate the heat production, but it will serve to minimize the damage to the impression.

When we examine the impression in snow, we see that the bottom of the impression is very porous. The snow or sleet packs tightly when impressed by the outsole of the footwear or tire. However, this rarely packs tightly enough to form a nonporous surface. Snow Print Wax or auto primer is often used to establish a barrier that provides a temporary nonporous surface atop the snow. Hold the aerosol can so that the impression is not damaged by the blast of propellants from the canister.

The Snow Print Wax (Figure 15.16a) or autobody primer paint (Figure 15.16c) is also used to lightly spray on the impression to highlight the raised areas of the impression. This will provide detail that was not visible from the impression in snow alone. Additional examination-quality photographs should be again taken. A total of three layers of spray is generally needed on each impression. Examination-quality photographs must be taken between each application. There should be approximately 1–2 min between each application to allow the spray time to dry.

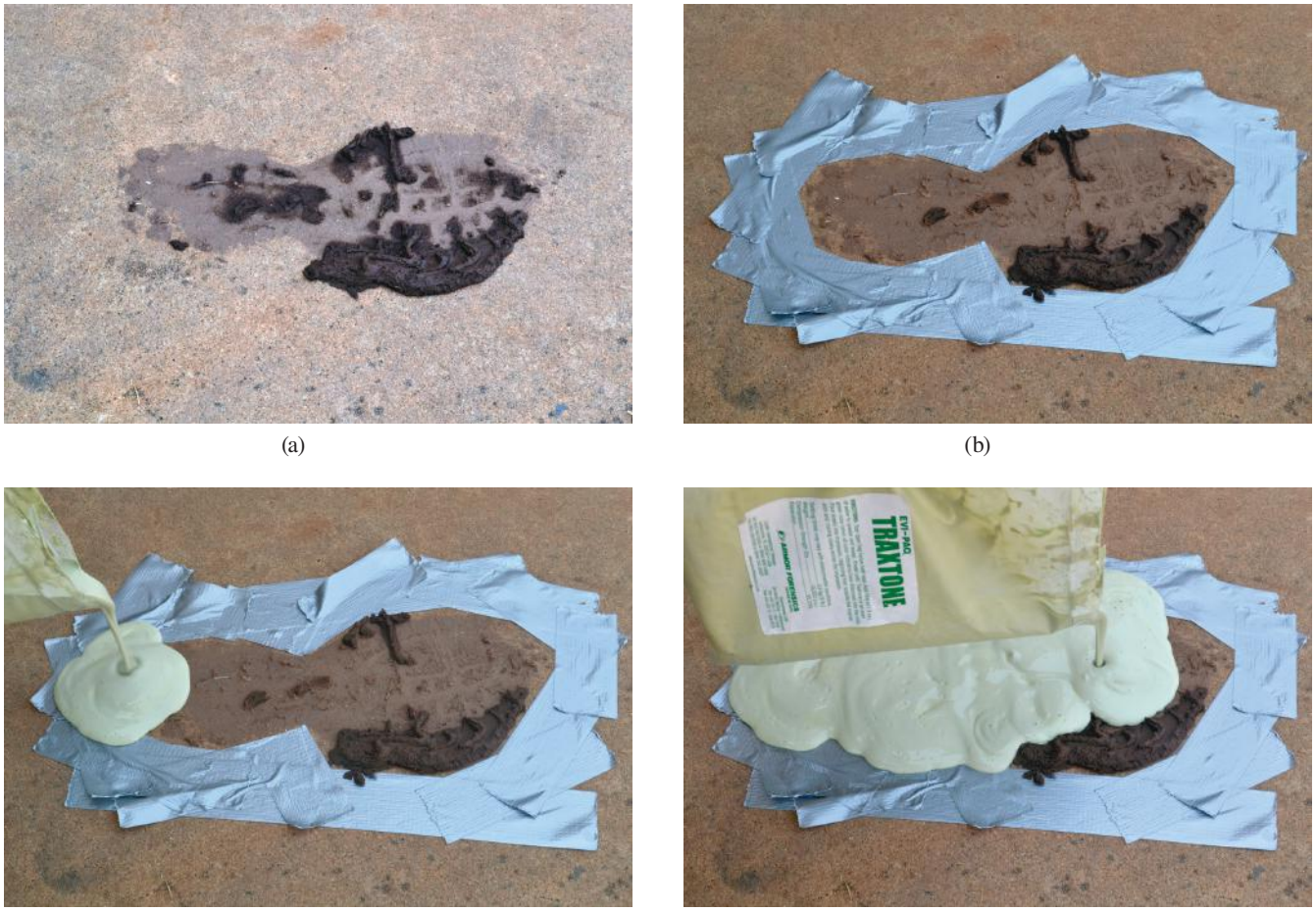
Casting Impressions in Sand

The sand is not your friend when it comes to casting. The sand will not hold its form once the casting medium is poured into the impression. Steps must first be taken to make the sand a more suitable surface for the casting medium. First the sand must be stabilized. The stabilization process requires multiple applications of the product. This is done in a layering format, where each layer adds a little more stabilization product to the previous application.

Once the impression has been properly stabilized, you may use gray autobody primer or Snow Print Wax to provide additional contrast for photographing. If the sand is very dry, you may need a wind block to prevent you impression from being damaged by the wind. Figure 15.17 presents images demonstrating a technique for casting footwear impressions in sand after they have been properly stabilized and photographed.

Collection of Cast

If the cast will release from the surface with little effort, simply remove and collect the cast. If additional force must be used, this may damage the cast or cause it to break into



(a) (b) (c) (d)

FIGURE 15.13 Images demonstrate the proper use of gray duct tape to "frame" an impression on concrete and then pouring of the casting media into the impression.

(a) (b)

FIGURE 15.14 Images demonstrate the use of a modified form for footwear impressions submerged in water.

several pieces. Use a shovel to loosen the soil next to and underneath the cast to avoid breaking or damaging the cast (Figure 15.18). The shovel is used to carefully loosen the soil around the entire cast. This is done on all sides of the impression. Care should be taken to avoid using the shovel as a lever to pry up the impression, as this may result in breaking the cast into several pieces. A flat shovel seems to be work well, since it will loosen the soil evenly as opposed to a curved pointed shovel. However, a pointed curved shovel can also be used successfully (Figure 15.18a). *Do not attempt to clean the cast*. Leave that decision to the laboratory technicians.

(a) (b) (c)

FIGURE 15.15 Images demonstrate the technique to cast a footwear impression submerged in water.

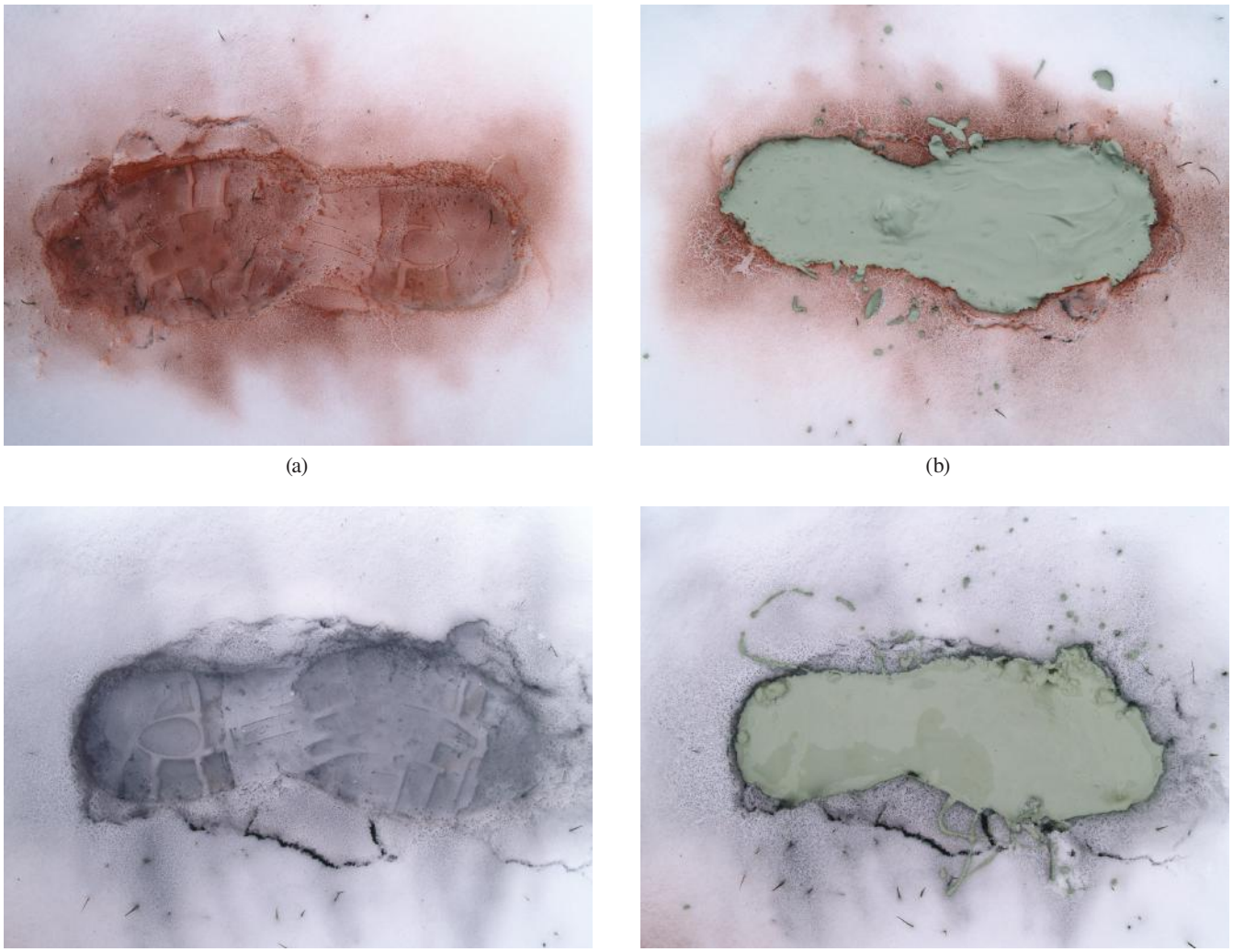
Collecting Cast from Concrete

Removal of a cast on concrete differs slightly in that the cast *must not* be removed until the cast is dry. This will add time onto the cast collecting, since there is no soil to conveniently loosen and remove the case. Allow the cast to air-dry. Begin by pulling up the tape around the cast (Figure 15.19b), being careful not to disturb the cast at this time. Once all the tape has been loosened around the entire cast, carefully begin lifting the cast by pulling on the duct tape (Figure 15.19d). Pull the tape up slowly as you work your way around the cast. If the attempt to lift the cast is done too soon, the cast may chip and break around the edges.

Electrostatic Lifting Procedures

This procedure involves electrically charging a metallic sheet of film that has been placed over the impression. Electrostatic devices use a grounding plate or instrument to ground the surface and a high-voltage power source (10,000–15,000 volts) to create the static charge in the lifting film. Remember that this technique will not work on wet origin impressions.

1. *Place the grounding plate*. Ideally, the grounding plate should be placed under the impressed surface. It can be placed next to the surface when this not an option.
2. *Prepare and position the lifting film over the impression* (Figure 15.20a). Place the black surface of the lifting material over the impression. Avoid sliding the film, as this will damage the impression. The lifting film should not contact the grounding plate. If the surface is metal, place a piece of polyester film or Mylar between the surface and the lifting film. The lifting film should be smaller than the polyester film or the Mylar. The top part of the lifting film should be marked with some form of orientation, such as an arrow or other appropriate marking. Impressions on a vertical surface may require the lifting film to be taped onto the surface
3. *Place the lifting probe on the lifting film*. The film will be drawn down onto the surface. If arcing or sparks are present, the voltage is too high or the lifting film is too close to the grounding plate. If air pockets remain in the lifting film, they may be rolled out using a fingerprint roller (Figure 15.20b). No more pressure than the weight of the roller is necessary to remove the air bubbles. Allow the charge to remain on the lifting film for approximately 5–10 s. Once the power is turned off, touch the probes to the grounding plate and film and allow the probe to remain in



(a) (b) (c) (d)

FIGURE 15.16 Images of footwear impressions cast in snow.

contact with the lifting film to discharge the film and prevent you from being shocked (Figure 15.20c).

4. *Remove the lifting film.* This is done by lifting the film from one corner or the other. Lay the lifting film flat on a clean, dry surface. Remember that the lifting fill will continually have some static charge on it; therefore, it may attract dust and other charged particles.

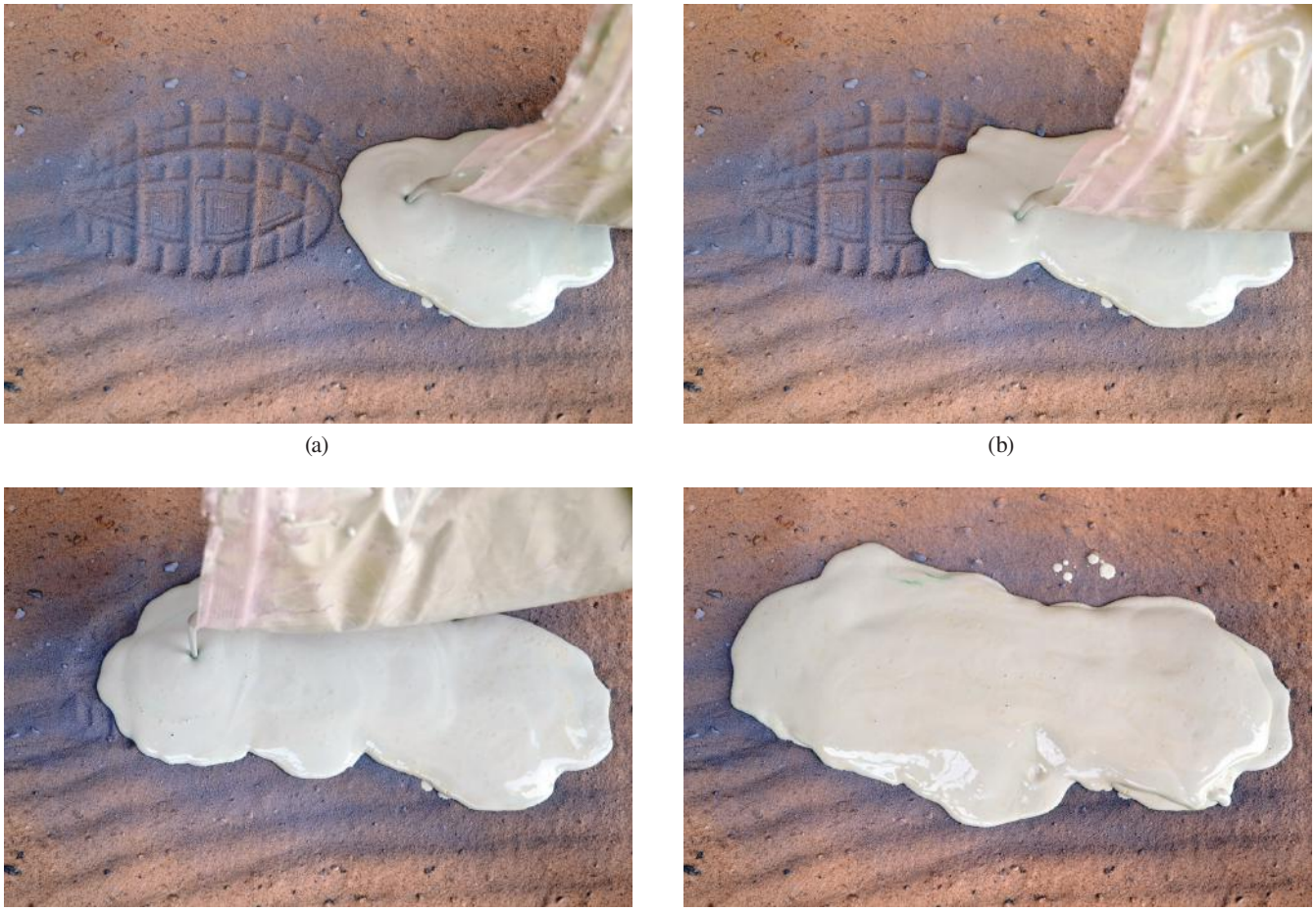
There are several different manufacturers of electrostatic lifting devices. Please consult the manufacturer's information that was provided with your equipment for the specific procedures.

CONVENTIONAL ENHANCEMENTS

Fingerprint Powders

Impressions of wet origin may also be developed using conventional fingerprint powders. If the impression is of dry origin, the use of fingerprint powders may not be as effective. They may be lifted using tape or gelatin lifters. When using this technique, it is recommended to test the specific powder on the surface in an area away from the suspected footwear impressions. There are times where a certain powder may develop the texture of the surface as well as the footwear impression. Magnetic powders tend to develop the texture of the surface less and the footwear impressions more (Figure 15.21). However, testing is the only method that will ensure that you have chosen the proper powder. Choose a powder color that contrasts with the gelatin lifters you will use. Magnetic powders tend to disturb the impression less than silk powder brushes.

Remove the clear cover from the gel side of the lifter. Attach one end of the gel lifter to the surface near the impression. Using an ink roller or a small wallpaper roller may be useful in smoothing out the gel lifter over the footwear impression (Figure 15.22b). The choice of powder color is dependent on the type of gel lifter your agency uses. Black gel lifters should be used with light-colored powders, and white and transparent gel lifters should be used with dark-colored powders. Once the gel lifter has been used to lift the footwear impression, replace the clear cover over the gel area (Figure 15.22c).

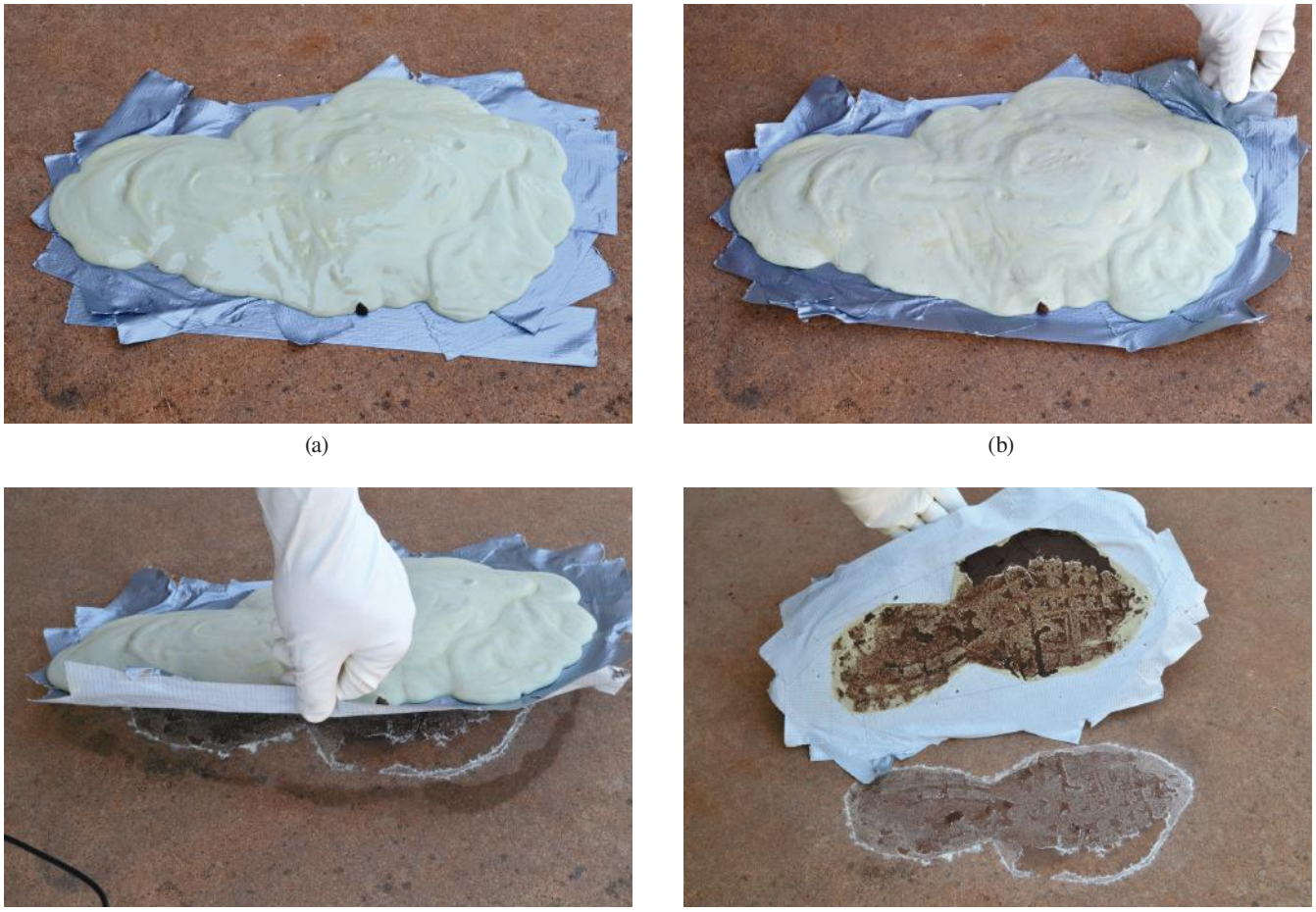


(a) (b) (c) (d)

FIGURE 15.17 Images of footwear impressions cast in sand.

(a) (b)

FIGURE 15.18 Images of the use of a flat-blade shovel to loosen the soil around the footwear impression to minimize damage to the cast.



(a) (b) (c) (d)

FIGURE 15.19 Images demonstrating the proper method of carefully lifting the cast footwear impression on concrete.

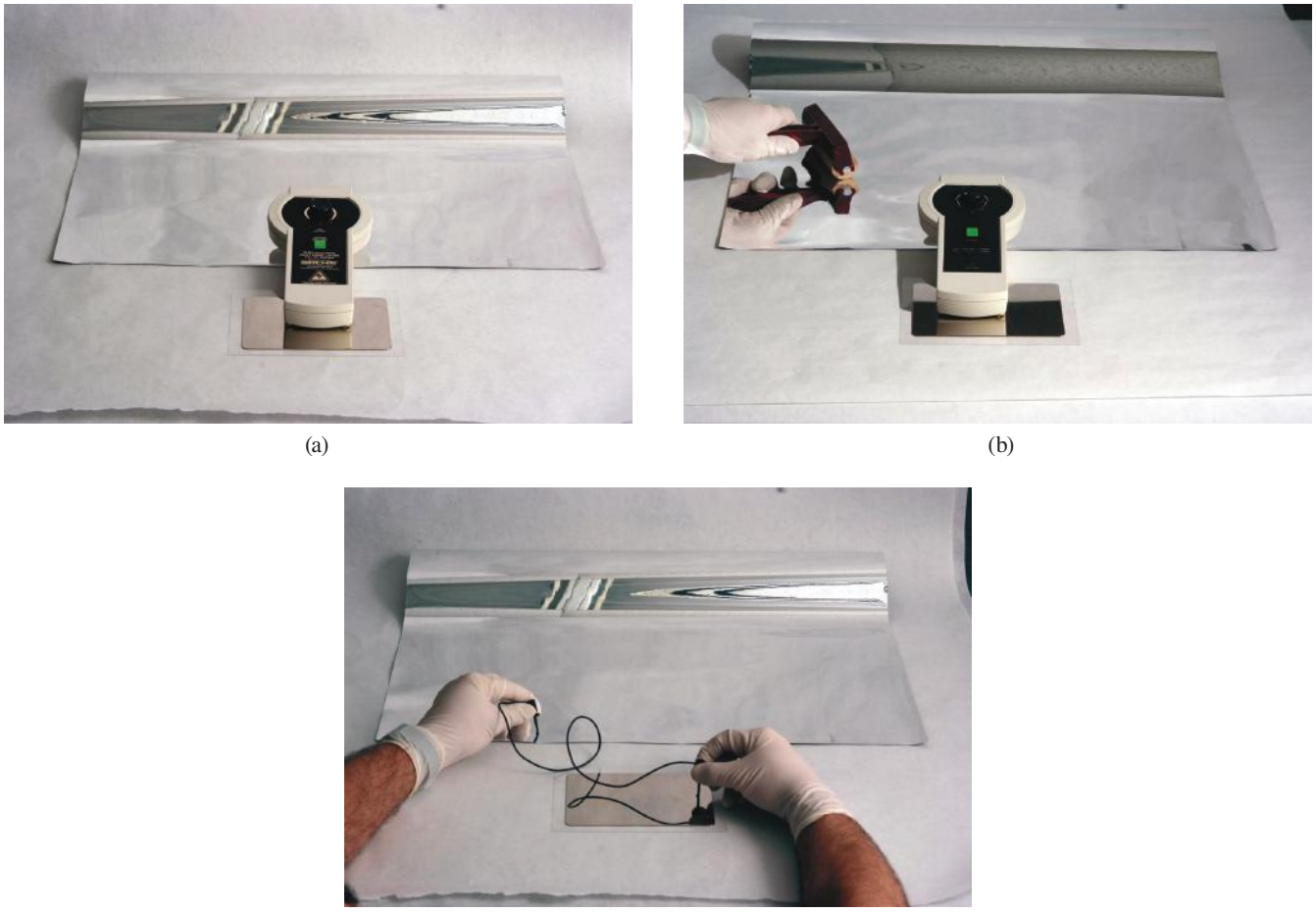
EXERCISE 15.1

Place a thin layer of Vaseline on the outsole of a shoe.
Place an impression on a linoleum or similar-type surface.
Use magnetic powder to develop the footwear impression.
Photograph the developed impression using the settings given in Photo Exercise 4.22.
Using a gel lifter, remove the clear backing film.
Lift the developed footwear impression.
Reattach the clear backing film to the gel lifter.
Properly photograph the developed footwear impression on the gel lifter.

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date of Crime:	Date Processed:
Location Processed:		Type of Impression: ☐ 2D ☐ 3D	Impression: ☐ Interior ☐ Exterior	

Method Used to Enhance Impression:	☐ Powder	☐ Chemical	☐ Other:	Lifting Technique:	☐ Casting	☐ Electrostatic Lifter	☐ Tape	☐ Gel Lifter	☐ Other:

Description of Impressions:



(a) (b) (c)

FIGURE 15.20 Images demonstrate the proper use of an electrostatic lifter.

EXERCISE 15.2

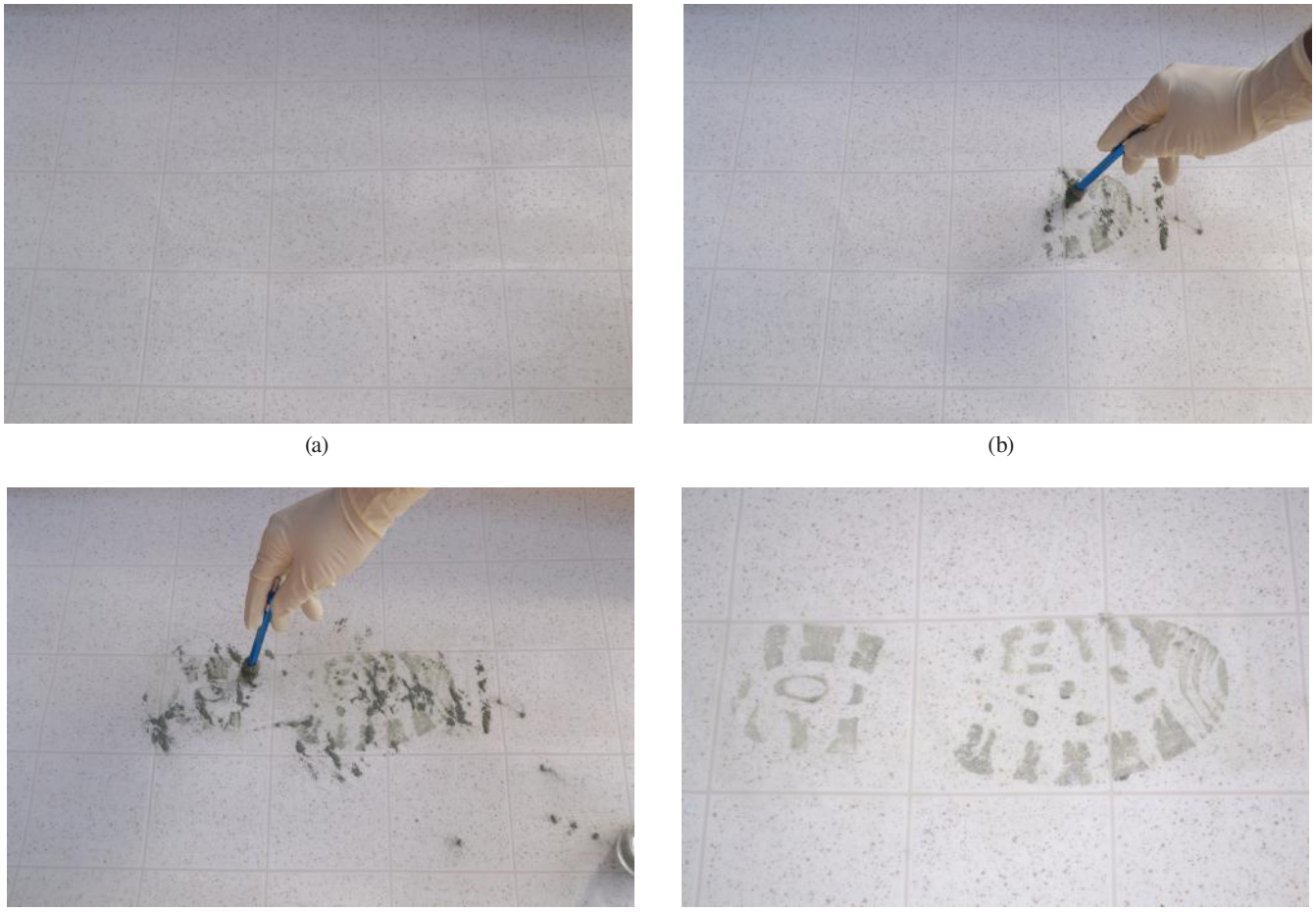
Place a footwear impression in soil.
Photograph the developed impression using settings given in Photo Exercise 4.22.
Using a casting medium, cast the impression.
Properly photograph the developed cast of the footwear impression.

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date of Crime:	Date Processed:

Location Processed:	Type of Impression:	☐ 2D	☐ 3D	Impression:	☐ Interior	☐ Exterior

Method Used to Enhance Impression:	☐ Powder	☐ Chemical	☐ Other:	Lifting Technique:	☐ Casting	☐ Electrostatic Lifter	☐ Tape	☐ Gel Lifter	☐ Other:

Description of Impressions:



(a) (b) (c) (d)

FIGURE 15.21 Images demonstrate the use of fingerprint powder to enhance a footwear impression.

EXERCISE 15.3

Place a footwear impression in sand.
Properly photograph the impression using the settings given in Photo Exercise 4.22.
Use a stabilizer to stabilize the impression.
Photograph the developed impression using the settings given in Photo Exercise 4.22.
Using a casting medium, cast the impression.
Properly photograph the developed cast of the footwear impression.

Description of Impressions:

Field Notes – Footwear Impression

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date of Crime:	Date Processed:

Location Processed:	Type of Impression:	☐ 2D	☐ 3D	Impression:	☐ Interior	☐ Exterior

Method Used to Enhance Impression:	☐ Powder	☐ Chemical	☐ Other:	Lifting Technique:	☐ Casting	☐ Electrostatic Lifter	☐ Tape	☐ Gel Lifter	☐ Other:

Description of Impressions:

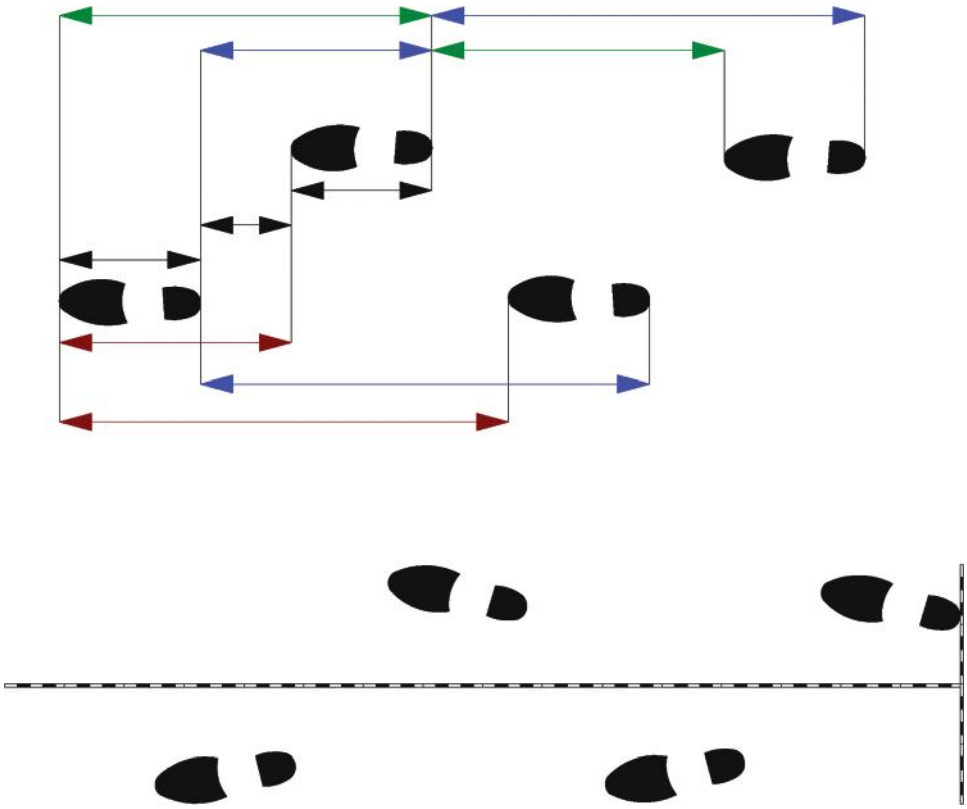


FIGURE 15.22 A field notes form to document footwear impressions.

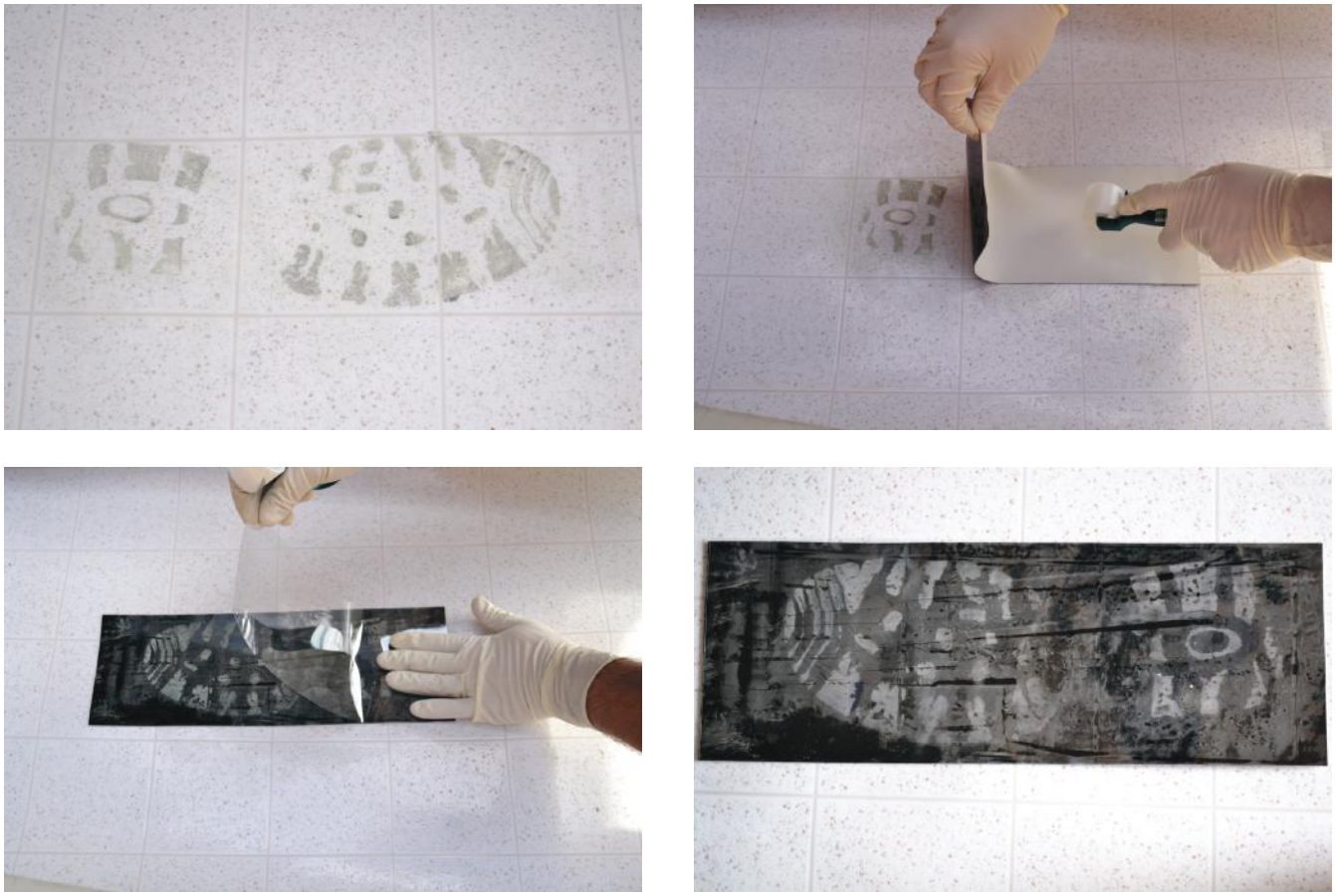


FIGURE 15.23 Images demonstrate the use of rubber/gel lifters to lift a footwear impression that was developed using magnetic fingerprint powders.

PHOTO EXERCISE 4.22

Footwear Impression

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Place the camera on a tripod.
2. Adjust the camera to aperture-priority mode.
3. Set the aperture to f/11.
4. Position the camera over the footwear impression so that the impression is positioned in a landscape format.
5. Be sure to use the appropriate scale and scale placement when photographing.

Footwear impression on linoleum or similar surface developed with magnetic powder:

1. Photograph the impression with available light and camera on tripod.
2. Photograph the impression with flash—from side of impression.
3. Photograph the impression with flash—from toe of impression.
4. Photograph the impression with flash—from heel of impression.
5. Photograph the impression with flash—from opposite side of impression.
6. Photograph the footwear impression on the gel lifter.

Footwear impression in soil:

1. Photograph the impression with available light and camera on tripod.
2. Photograph the impression with flash—from side of impression.
3. Photograph the impression with flash—from heel of impression.
4. Photograph the impression with flash—from toe of impression.
5. Photograph the impression with flash—from opposite side of impression
6. Photograph the cast.

Footwear impression in sand:

1. Photograph the impression with available light and camera on tripod.
2. Photograph the impression with flash—from side of impression.
3. Photograph the impression with flash—from heel of impression.
4. Photograph the impression with flash—from toe of impression.
5. Photograph the impression with flash—from opposite side of impression.
6. Rephotograph the impression after being sprayed with the stabilizer.
7. Photograph the cast.

All photographs in this exercise are examination-quality photographs. If flash is not available, use a flashlight for your side lighting and appropriate shutter speed and f/stop.

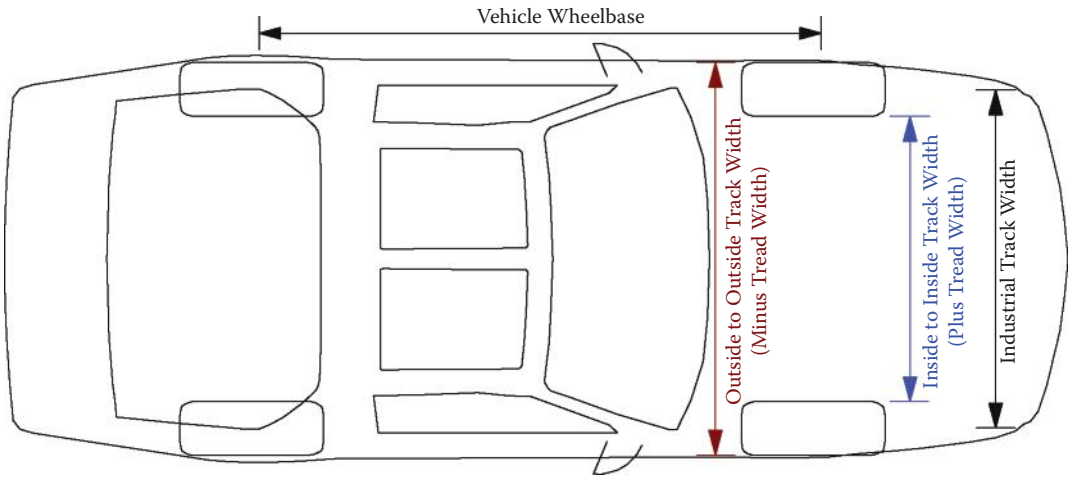


FIGURE 15.24 Illustration of the proper tire track measurements that should be obtained at the scene.

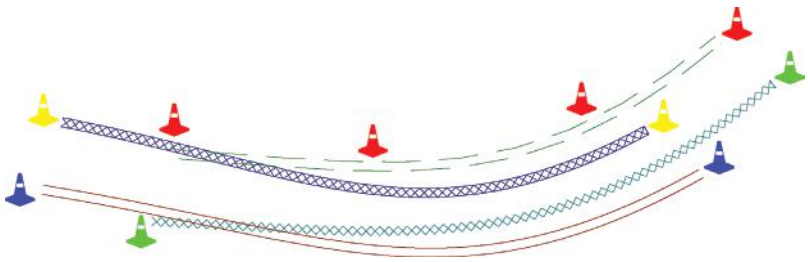


FIGURE 15.25 Illustration of the proper cone placement to photograph the overall length and location of a tire track.

TIRE TRACK EVIDENCE

Track width may be measured from the center of one tire to the center of the opposite tire on the same axle. It may also be measured from inside to inside as well as outside to outside. Outside-to-outside measurements must have the tread width subtracted out to obtain the center-to-center measurements (the right measurements in Figure 15.27). The inside-to-inside measurements must likewise have the tread width added in order to obtain the center-to-center measurements. There are databases that contain this general information. These databases do not take into account the various tire sizes. Recording this information directly from the vehicle is the best practice.

Wheelbase

There are databases that provide most of the vehicle measurements. These databases do not take into account the use of larger tires or other similar modifications that may be made on a vehicle. It is always best to obtain these measurements directly from the vehicle itself (the top center measurement in Figure 15.24). Although these are good measurements to obtain from a vehicle, there will generally never be enough information from impressions left at the scene in order to obtain this information from the actual impressions. The vehicle size affects the overall turning radius. This information may be helpful in narrowing down the possibilities of vehicle sizes.

Tire Position in a Turn

When a vehicle leaves tire marks or impressions, knowing the tire position in the turn is important.

Photography

Colored evidence cones may be used to mark the various tracks. Place a cone at the beginning and end of the individual tracks. Depending on the length of the tracks, it may be necessary to place cones at points along the tire tracks (Figure 15.25). Care must be taken to ensure that the cones are not placed on top of the tire tracks.

When all four tire tracks are present, care must be taken to measure from front tire to front tire and from rear tire to rear tire. Certain measurements should be made of each tire track. Figure 15.26 illustrates the proper measurements of tire tracks.

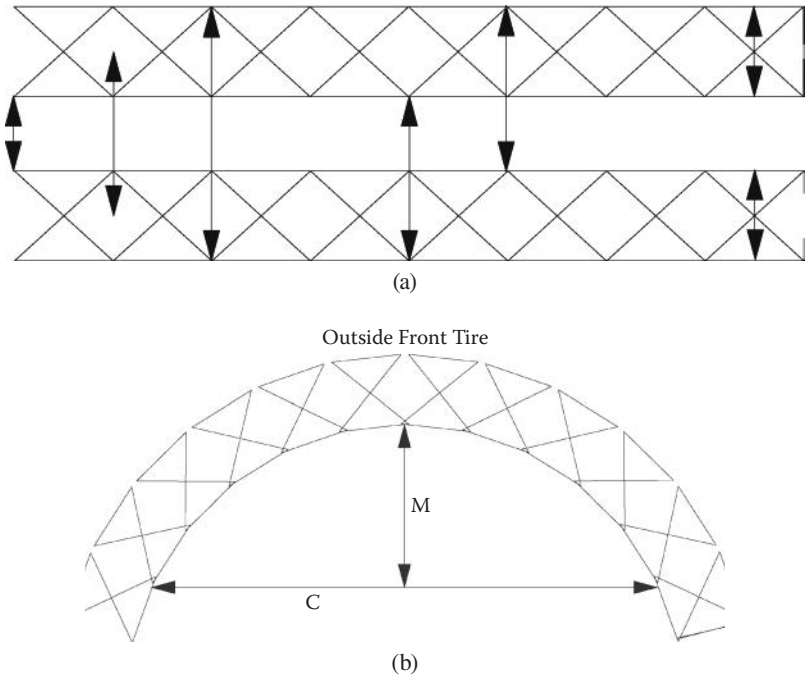


FIGURE 15.26 Illustrations of proper tire track measurements.

EXERCISE 15.4

Locate a tire mark in the parking lot.
Properly mark the tire mark with cones.
Properly obtain the necessary measurements of the tire track.
Photograph the developed impression using the settings given in Photo Exercise 4.23.

Field Notes – Tire Impressions

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date of Crime:	Date Processed:

Location Processed:	Type of Impression:	☐ 2D	☐ 3D	Impression:	☐ Interior	☐ Exterior

Method Used to Enhance Impression:	☐ Powder	☐ Chemical	☐ Other:	Lifting Technique:	☐ Casting	☐ Electrostatic Lifter	☐ Tape	☐ Gel Lifter	☐ Other:

Driver Front:	DOT No.:	Tire Size:	☐ White Wall	☐ Non White Wall	Tire Pressure:	Driver Front:	Tire Tread Description:
Driver Rear:	DOT No.:	Tire Size:	☐ White Wall	☐ Non White Wall	Tire Pressure:	Driver Front:	Tire Tread Description:
Pass Front:	DOT No.:	Tire Size:	☐ White Wall	☐ Non White Wall	Tire Pressure:	Driver Front:	Tire Tread Description:
Pass. Rear:	DOT No.:	Tire Size:	☐ White Wall	☐ Non White Wall	Tire Pressure:	Driver Front:	Tire Tread Description:

Description of Impressions:

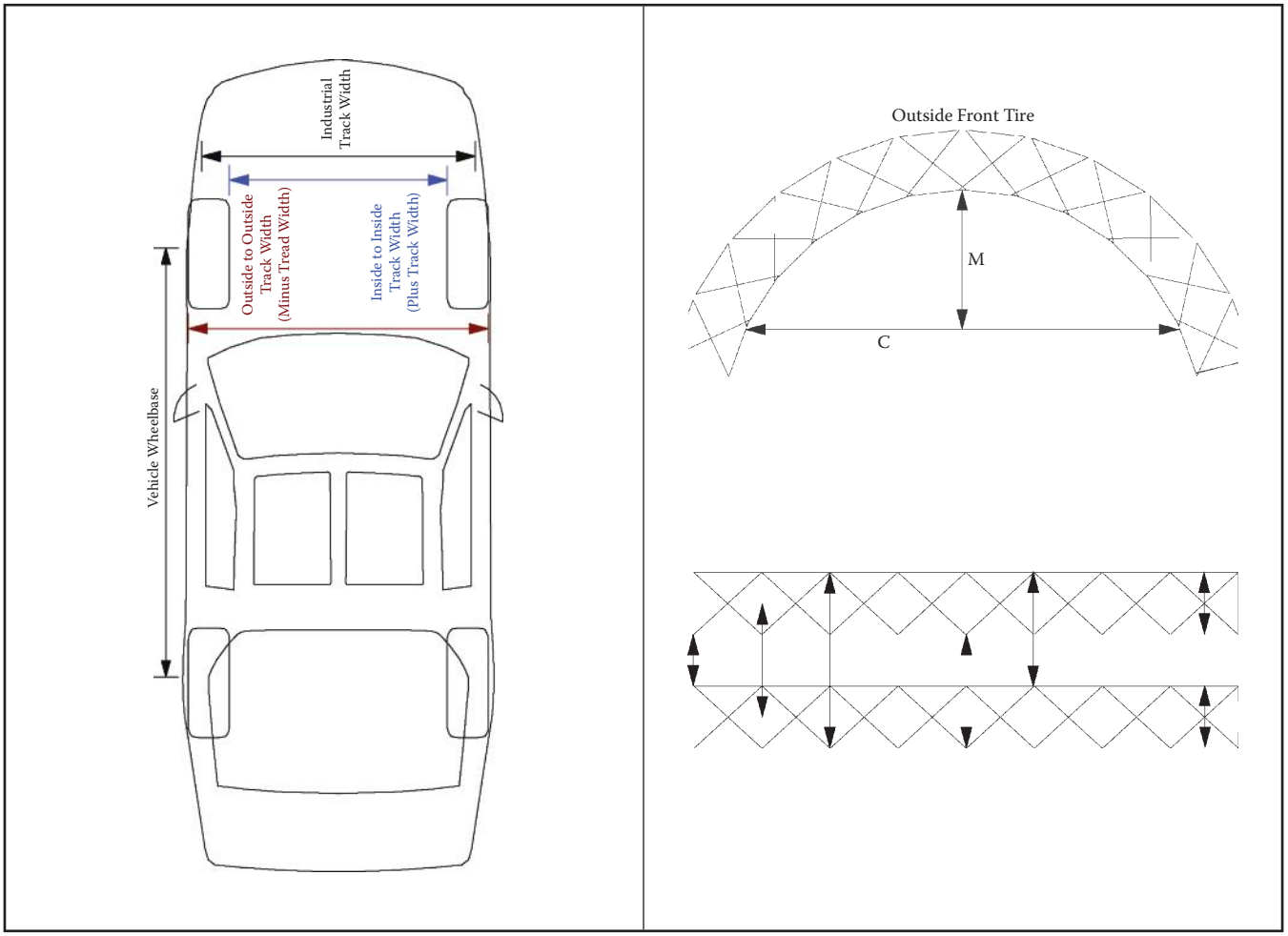


FIGURE 15.27 A form to document tire impressions.

PHOTO EXERCISE 4.23

Tire Impressions

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Place the camera on a tripod.
2. Adjust the camera to aperture-priority mode.
3. Set the aperture to f/11.
4. Position the camera over the tire impression so that the impression is positioned in a landscape format.
5. Be sure to use the appropriate scale and scale placement when photographing.

Tire impression in dirt

1. Photograph the tire impression with available light and camera on tripod.
2. Photograph the tire impression with flash—from side of impression.
3. Photograph the tire impression with flash—from opposite side of impression.
4. Photograph the tire impression with flash—from end (parallel) of impression.
5. Photograph the tire impression with flash—from opposite end (parallel) of impression.

All photographs taken during this exercise are examination-quality photographs. If flash is not available, use a flashlight for your side lighting and appropriate shutter speed and f/stop.

16 Exercises for Digital Evidence

EXERCISE 16.1

Locate a computer in a room.
Properly photograph the computer and monitor.
Document what is on the screen.
Photograph *how* the peripheral components are attached to the main computer using the settings given in Photo Exercise 4.24.
Figure 16.1 is a form that may be useful in documenting computer/cellular evidence.

PHOTO EXERCISE 4.24

Computer/Cellular Phone

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

Computer
1. Locate a computer in a room.
2. Properly photograph the front of the computer and monitor using the settings given in Photo Exercise 4.24.
3. If the computer is in sleep mode, slightly move the mouse and photograph the screen.
4. Photograph all the peripherals attached to the computer.
5. Photograph *how* the peripherals are attached to the computer.

Cellular phone
1. Locate a cellular phone in a room.
2. Properly photograph the front of the cellular phone using the settings given in Photo Exercise 4.24.
3. Photograph all sides of the cellular phone.
4. Photograph the screen and its contents.
5. If the cellular phone is capable of having the battery removed, remove the battery and photograph the make and serial number of the phone.

Computer/Cellular Evidence Collection Notes

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:	Date of Crime:	Date Processed:

Location Processed:	Received Time:	Arrival Time:	Departure Time:	☐ Warrant	☐ Waiver	☐ None

Contact a member of the state or local Computer Forensics Unit to respond and collect the computer evidence. If one is not a available or cannot respond this form may be completed during the collection of the computer equipment to ensure it is properly documented and collected. Improper collection of computer evidence may result in loss of valuable data.

Has This Evidence or Computer(s) been previously viewed or accessed by anyone?:	☐ Yes	If Yes, Please Attach Supplemental Explaining Who Accessed the Computer and Why.	☐ No	Are You Aware of Any Priviledged Information (ex. Medical, Legal, etc.:	☐ Yes	If Yes, Pelase Attach Supplemental Explaining the Priviliged Information	☐ No

Initially preserve the state of the evidence, do not alter the condition of any electronic device. If it is on, leave it on. If it is off, leave it off.
Identify telephone lines attached to devices (Document phone lines; Disconnect phone lines and Label phone lines)

Device Owner(s):	Device Make:	Device Model:	Device Serial No.:	Device Username:

Device Password:	BIOS Password:	System Login Password:	Network or ISP Password:	Application File Password:
Encryption Pass Phase Password:	E-mail Password:	Access Token Password:	Scheduler Password:	Contacts Passwords:

Purpose of System:	Any Unique Security or Destructive Devices:	Any Offsite Data Storage:	Documentation Explaining the Hardware or Software installed on the System:

Mouse Position/ Location:	☐ Left	☐ Right	☐ Other:	Location of Other Components Relative to Each Other:

Power Status:	☐ On	☐ Off	☐ Sleep mode	Power Status Light:	☐ On	☐ Off	☐ None	Fan Noise:	☐ Yes	☐ No	Computer Temperature	☐ Warn	☐ Hot	☐ Cold

Identify and document related electronic components that will not be collected.
Photograph/Notes: Front of computer; Front of monitor and If active program is running, consider videotaping monitor
DO NOT MOVE ANY COMPONENTS UNTIL PROPERLY POWERED DOWN
Computers attached to a network (Business or Home) should **only** be recovered by specially trained personnel

Monitor Status:	☐ On	Monitor On - Photograph and Record Visible Information:
Monitor Status:	☐ Sleep mode	Monitor - Sleep Mode, Slightly Move Mouse (DO NOT PUSH BUTTONS OR PUSH KEYS) - Photograph and Record Information:
Monitor Status:	☐ Off	Turn on Monitor - Photograph and Record Visible Information (May Have to Slightly Move Mouse):

Remove power cord from computer. Laptops must have batteries (look for secondary battery) removed as well.
Cell phone batteries are also removed.
If there is no battery, power off the cell phone in the normal manner.
Check for other connections to Computer (phone, DSL, etc.) and determine phone number is possible.
Remove floppy disks and label and package separately
Leave CDs in CD drive (Do Not Touch CDs or CD drive)
Place tape over all drive slots and over the power cord connector.
Photograph, diagram and label all connections to the computer and corresponding cables.
Identify all peripheral devices, laptop docking stations
Determine if WIFI or hardwire network cable or routers are being used by the computer
DO NOT OPERATE electronic devices, unless an emergency exits
If emergency exists, document all actions performed on the device.
Package electronic evidence in a manner to minimize the loss of trace evidence and/or fingerprints.
Consider using antistatic packaging material or antistaitc plastic bags
Avoid folding, Bending or scratching computer media
Package and label multiple computer systems in a manner that can facilitate reassembly.
Additional Information:

FIGURE 16.1 An illustration of a form that may be useful in documenting computer/cellular evidence.

17 Exercises for Injury Documentation

INJURY DOCUMENTATION

Injuries, if properly documented, may provide some very useful information. We need to begin with some medical terminology used in the medical field. Terminology describing locations is based on "anatomically correct" body orientation. The body is positioned with the arms down to the side with the palms facing forward.

Open Wounds

Open wounds are classified according to what caused the opening. Incisions or incised wounds are caused by a clean, sharp-edged object such as a knife, razor, or glass. Lacerations are irregular tear-like wounds caused by blunt-force trauma. Abrasions are superficial wounds, where the topmost layer of skin is scraped off. Puncture wound are caused by an object puncturing the body, such as a knife. Gunshot wounds are caused by a bullet or projectile penetrating or perforating the body.

Closed Wounds

Contusions are commonly known as bruises. Hematomas are caused by damage to a blood vessel that in turn causes blood to collect under the skin. Crushing injuries are caused when a great or extreme amount of force is applied over a long period of time. Fractures are a break in the continuity of the bone. Stellate tearing is a tearing of the skin that resembles a star.

Bruising

When an injury occurs that results in the formation of a visible bruise, the bruising is obviously visible within moments of the injury. After several days to a week or so, the bruising disappears. Research has shown that the bruising remains in the epidermal layer for quite some time, some for up to 9 months. Bruising in children seems to disappear much more quickly than in adults. It may be possible to document bruising for days to weeks after the bruise has faded. Use of long-wave UV to 415-nm light with a yellow filter may show discolorations that are either faint or no longer visible. Use the term *discolorations*. A medical physician must examine the individual and the photographs to rule out a medical condition such as skin cancer or some other medical process.

Mongolian Spots

This is a bluish or mulberry-colored rounded or oval discoloration on the sacral region due to the ectopic presence of melanocytes in the dermis.

Scarring

Scars have been documented for years after the event causing the scar. Use a long-wave UV light to 415-nm light and yellow filter to visualize the scar.

Burns

Burns have been documented for as long as 30 years post incident. They are documented in the same manner as bruising and scarring injuries.

Bite Marks

Bite marks fall into offensive and defensive categories. Offensive bite marks are often associated with an arousal situation. They are generally limited to a single bite mark to a few bite marks. They are well defined and contain an enormous amount of detail. Defensive bite marks are associated with the defending actions. These marks are numerous marks and less-defined patterns. Defensive bite marks contain little useful detail. Swab the bite mark prior to placing any scale on the area. If the victim has cleaned up, locate the towels used and collect these items. Ensure that these items are properly air-dried prior to submitting.

These pose special issues in documenting. First, the area containing the bite mark is rarely flat. Acquisition of good examination-quality photographs poses problems that must also be considered and dealt with. The examination-quality photographs are taken in stages:

First Stage: Document the bite-mark from multiple sides. Remember that the scale must be flat on the surface. If the surface is curved, multiple photographs may be necessary to properly document the bite mark.

Second Stage: The area containing the bite mark must be repositioned in the same position as when the bite occurred. Additional examination-quality photographs are then taken in this position. Bite-marks may be cast using

1. Forensic Sil
2. Dental stone
3. Traxtone
4. Mikrosil

Caution must be used not to manipulate the skin while casting the area. This may cause the bite mark to also be deformed and not be a true representation of the bite mark.

EXERCISE 17.1

The students will document the bruising, scars, and burns on other students in the class.

Bruising

Scars

Burns

PHOTO EXERCISE 4.25

Alternate Light Source: Injury Documentation

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Manual Mode	**Shutter Speed:** As Determined	**Aperture:** As Determined	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Examine bruises or injuries on exposed areas of classmates.
2. Using a 415-nm blue light, photograph the injuries.
3. Repeat the exercise using an ultraviolet light.

Section V

Special Considerations

18 Exercises for Shooting Scene Documentation

BALLISTICS

Internal ballistics refers to events inside the firearm. *External ballistics* refers to events after the projectile leaves the firearm. *Terminal ballistics* refers to the events occurring when the projectile strikes a surface.

PROPER DOCUMENTATION OF SHOOTING SCENE

Proper documentation of a shooting scene allows the analyst to establish a parameter from which the shooter may have been. It includes:

1. Photographs
2. Notes
3. Pertinent measurements
4. Sketches
5. Chemical testing

BULLET DEFECT LABELING

There are two schools of thought: projectile defect and bullet defect. A projectile defect takes into account that a bullet is a projectile that made the hole or defect. Projectiles also include arrows, darts, rocks, BBs and pellets, etc. The mathematical principals for shooting-scene reconstruction have been validated (i.e., court accepted) only for one kind of projectile, that of bullets. If the term *projectile defect* is used, then some additional descriptions are necessary to describe the projectile defect as having been caused by a bullet and no other type of projectile. The more appropriate term is *bullet defect*.

Proper Measurements to Document Bullet Defects

Proper use of trajectory rods to document the shooting incident is paramount. Trajectory rods are not just used for visual photographs, If there is a secondary defect that can exclusively be associated with the primary defect, a trajectory rod is then used to document that defect with photographs and measurements.

Locating an Exclusive Secondary Defect

The use of a small light, fiber-optic scope, video borescope, or cutting a view hole into the surface are very useful aids when looking for the secondary bullet defects.

Proper Rod Placement

Once the exclusive secondary bullet defect has been located, carefully insert the trajectory rod into the primary bullet defect. Do not rely on the bevel of the bullet defect to locate the secondary bullet defect, as this will result in improper trajectory rod placement. One can use the beveling as a "guide" to the direction of the secondary bullet defect. Carefully insert the trajectory rod into the secondary bullet defect, do not force the trajectory rod into the defects. Once the trajectory rod is in place, use centering cones to assist in lining up the trajectory rod with the center of the bullet defect. O-rings may be used to hold the trajectory rod and/or centering cones in place.

Measurements of the Bullet Defect and Trajectory Rod

The first measurements are of the bullet defect itself. The bullet defect may be measured from the center of the defect or either edge. Whichever landmark you choose to use must be documented. The vertical measurement is taken from the floor or ground to the defect. The horizontal measurement is taken from the bullet defect to an adjacent wall.

The trajectory rods are then carefully inserted into the primary and secondary bullet defects. The vertical measurement is obtained from the tip of the rod to the floor or ground. The horizontal measurement is made from the tip of the rod to an adjacent wall, using the same wall that was used to obtain the vertical measurement of the bullet defect. The length of the trajectory rod protruding out of the wall must also be measured. Figure 18.1 illustrates the various measurements necessary for the bullet defect itself as well as the trajectory rod.

Azimuth or Horizontal Angle

Using the 0–180° protractor, we now obtain the azimuth angle of the trajectory rod and the wall. The protractor must be level to the horizontal plane in order to accurately measure the horizontal angle. If the protractor is not level, your measurements will be inaccurate, and may be so inaccurate that the angle values are useless. The protractor may be leveled by a torpedo level (Figure 18.2a). A plumb bob may also be useful in reading the measurement (Figure 18.2b), especially when the trajectory rod is at such a large angle above the horizontal plane.

Ideally, the protractor should be placed above the trajectory rod so that the trajectory rod may easily be seen through

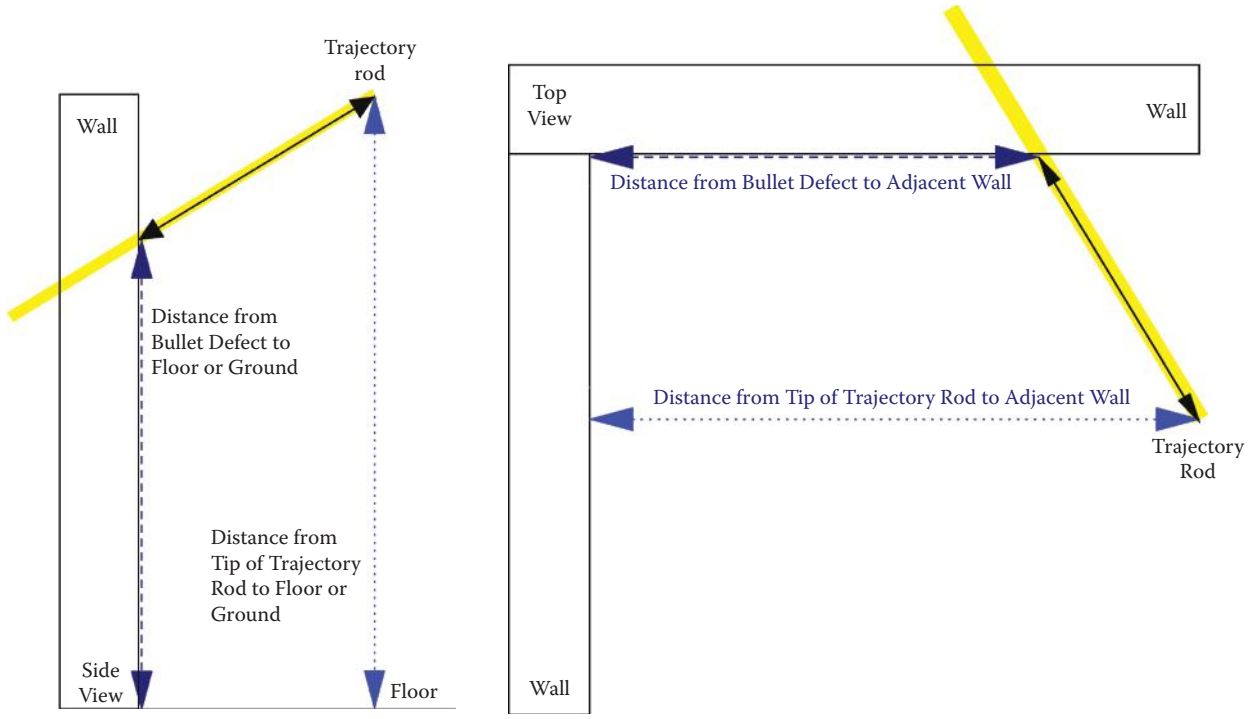
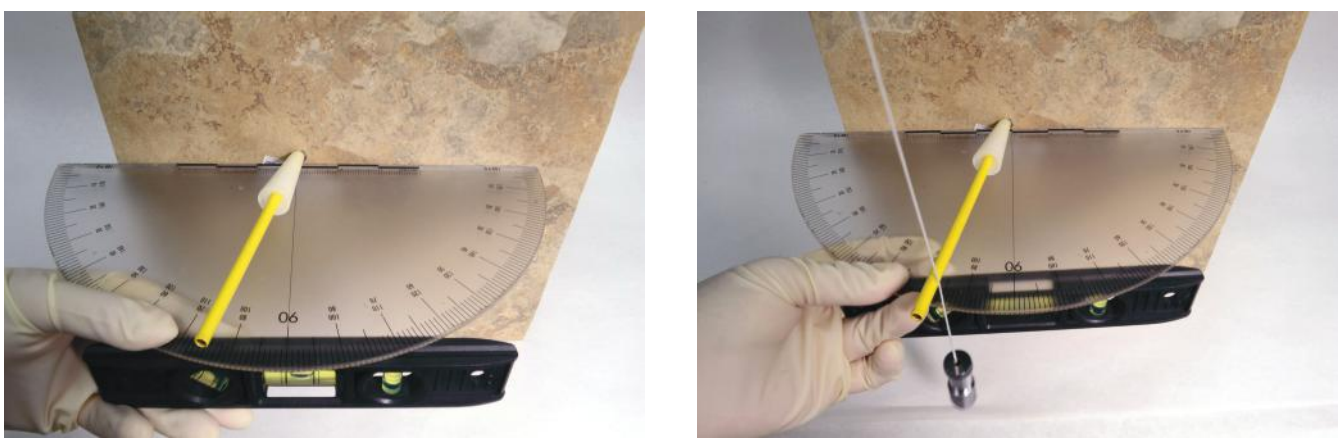


FIGURE 18.1 Illustrations of the proper measurements for the bullet defect and the trajectory rod.



(a) (b)

FIGURE 18.2 Images of using a level and plumb bob to assist in measuring angles using a protractor.

the semitransparent protractor. This allows for the horizontal measurement to easily be seen using the protractor in the background. If the protractor must be placed below the trajectory rod, the reading of the measurements is a little more difficult and, in some instances, may require the use of a plumb bob. If the reference point is aligned along the center of the trajectory rod (Figure 18.3a), the measurement of the trajectory rod must also be taken from the center of the trajectory rod. If aligning the reference point of the protractor against the left edge of the trajectory rod (Figure 18.3b), the measurement must be taken from the left edge of the trajectory rod. The same applies for aligning the reference edge along the right edge of the trajectory rod (Figure 18.3c).

Vertical Angle

There are several techniques that may be used to obtain this angle measurement. First, you can simply turn the protractor 90° so that it is perpendicular to the ground. Obtain the vertical measurement of the trajectory rod. The measurement is again taken corresponding to the placement of the reference line of the protractor (Figure 18.4). Note that the vertical angle is measured in relation to the horizontal plane. Preferably, the protractor is placed on the same side of the trajectory where the camera is placed. If this is not possible, the protractor is placed behind the trajectory rod and the measurements are taken based on how the reference line is oriented with the trajectory rod.

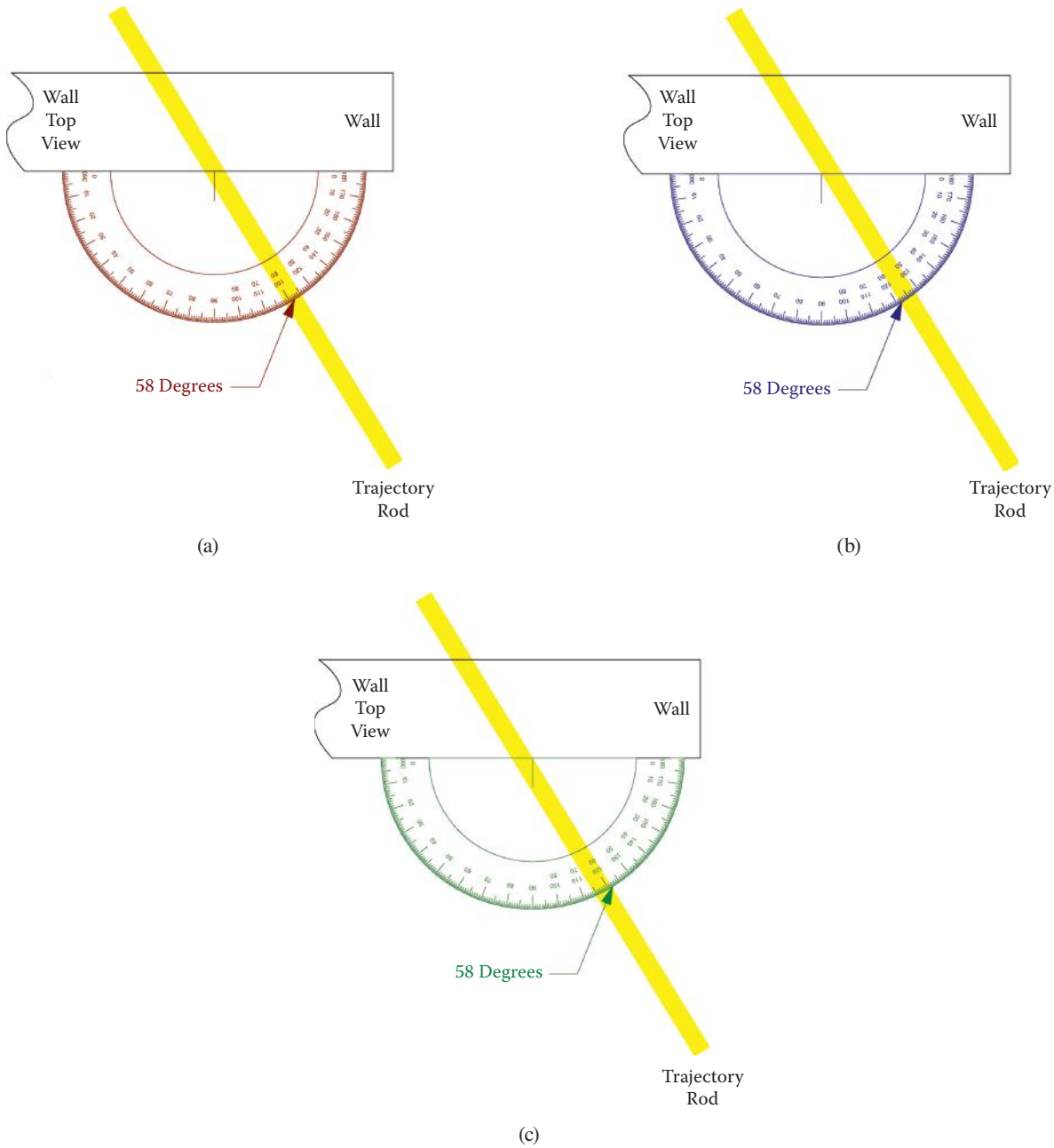


FIGURE 18.3 Illustrations of taking the azimuth or horizontal angle dependent on how the reference line is aligned with the trajectory rod.

The vertical angle may also be obtained using an angle gauge and/or a smart level. The angle gauge has a reference mark that is used to read the angle (Figure 18.5a). It is imperative that the angle gauge be held vertically so that this reference mark is hanging freely, allowing the angle to be read. If the angle gauge is held at an angle other than vertical, the reference line may rest against the front or back of the angle gauge, resulting in an inaccurate measurement of the angle. Due to the heavy weight of the smart level, it may be necessary to support the trajectory rod with your hand while the smart level is in contact with the trajectory rod (Figure 18.5b). Avoid simply just setting the smart level on the trajectory rod, as the weight of the smart level may cause damage to the bullet defect.

Documenting Bullet Defects Using the Entrance and Exit Defects

The horizontal and vertical measurements of the entrance bullet defect and the exit bullet defect are measured. A trajectory rod is then placed in the primary bullet defect and the proper secondary bullet defect. The trajectory rod is marked at the entrance of the primary defect and the exit of the secondary defect. Care must be taken not to move the trajectory rod while it is being marked. The trajectory rod is then removed and the distance between the marks is measured. This distance will be the length of the trajectory rod. Figure 18.6 shows images demonstrating the technique to obtain the measurements using this particular method.

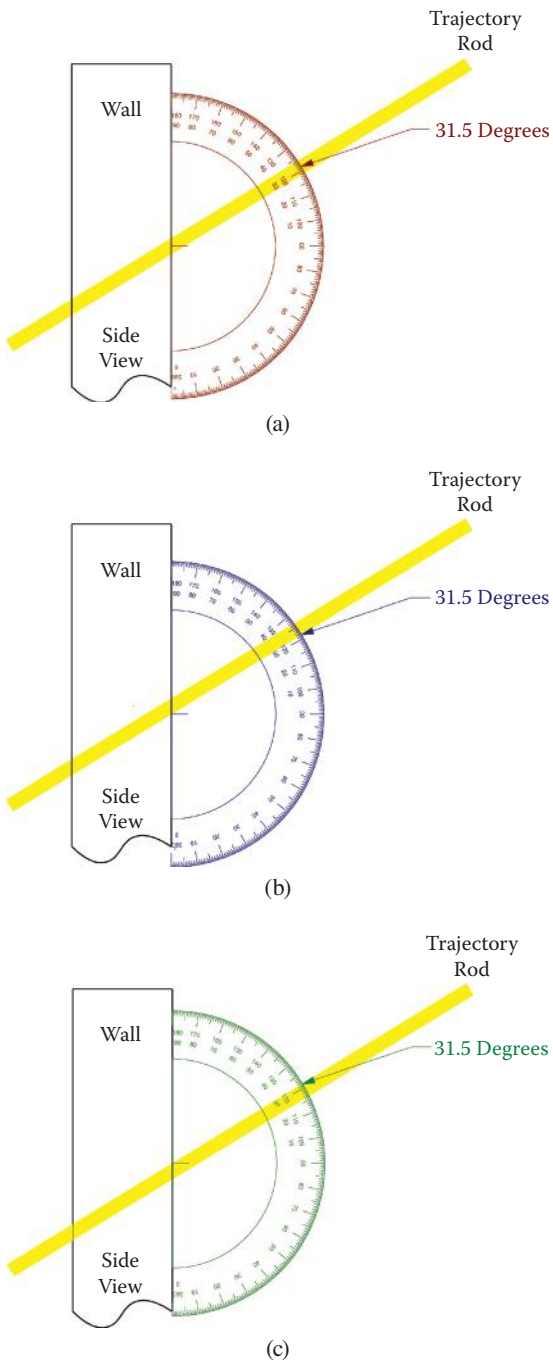


FIGURE 18.4 Images demonstrate the proper method to obtain the vertical angle measurements depending on how the reference line of the protractor is aligned with the trajectory rod.

Shotgun Patterns

Shotgun patterns are relatively easy to measure. The center of the pattern is measured vertically up from the floor or ground and horizontally from the edge of the wall (Figure 18.7a). The height and width of the overall pattern is then measured (Figure 18.7b). Most shotgun pellets do not afford the opportunity to document them using a trajectory rod.

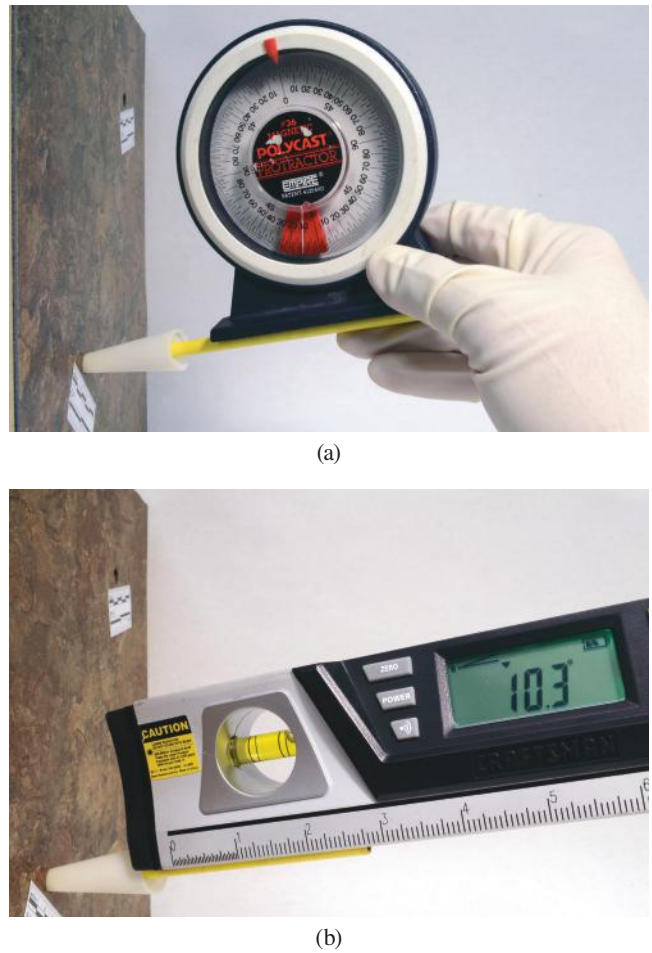


FIGURE 18.5 Images demonstrate the use of (a) an angle gauge and (b) a smart level.

Vehicle Edge Reference

The straight edge (vertical measuring device) should be placed as close as possible to the bullet defect being measured. Vehicles are not known for being perfectly square, so by placing the straight edge near the bullet defect, you can take the measurements without having to take the curvature of the vehicle into account. Using a second, smaller straight edge or tape measure (horizontal measuring device), the bullet defects can then be measured inward from this reference edge. This second straight edge is also leveled with a torpedo level. Care must be made in ensuring that the measuring device is always level vertically. If this process is used, the trajectory rod may be adjusted so that the tip is even with the edge of the vehicle used as a reference. The length of the trajectory rod extending from the bullet defect is then measured.

In the event that it is not possible to align the tip of the trajectory rod with the door edge of the vertical measuring device, one additional measurement is necessary. This measurement is from the tip of the trajectory rod outward from the door edge of the vertical measuring device. Figure 18.8 illustrates the necessary measuring technique to document bullet defects using this method.

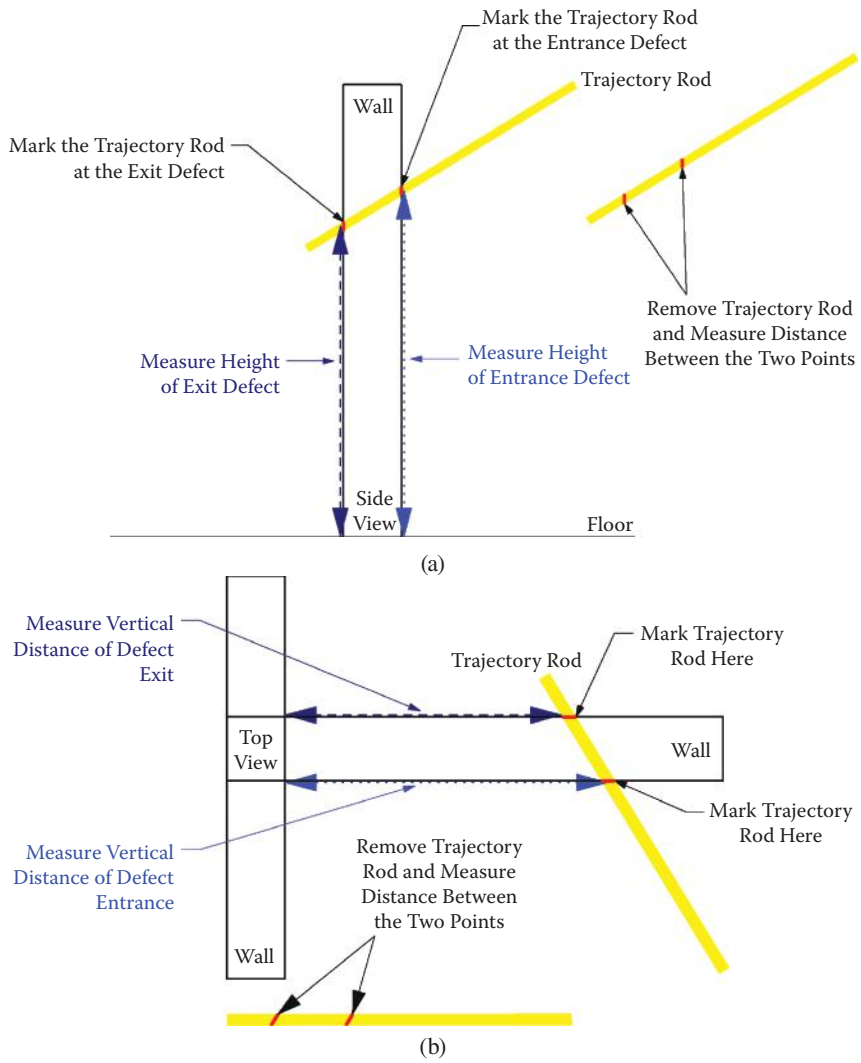


FIGURE 18.6 Images demonstrate the technique to use the entrance and exit bullet defects to obtain the necessary measurements.

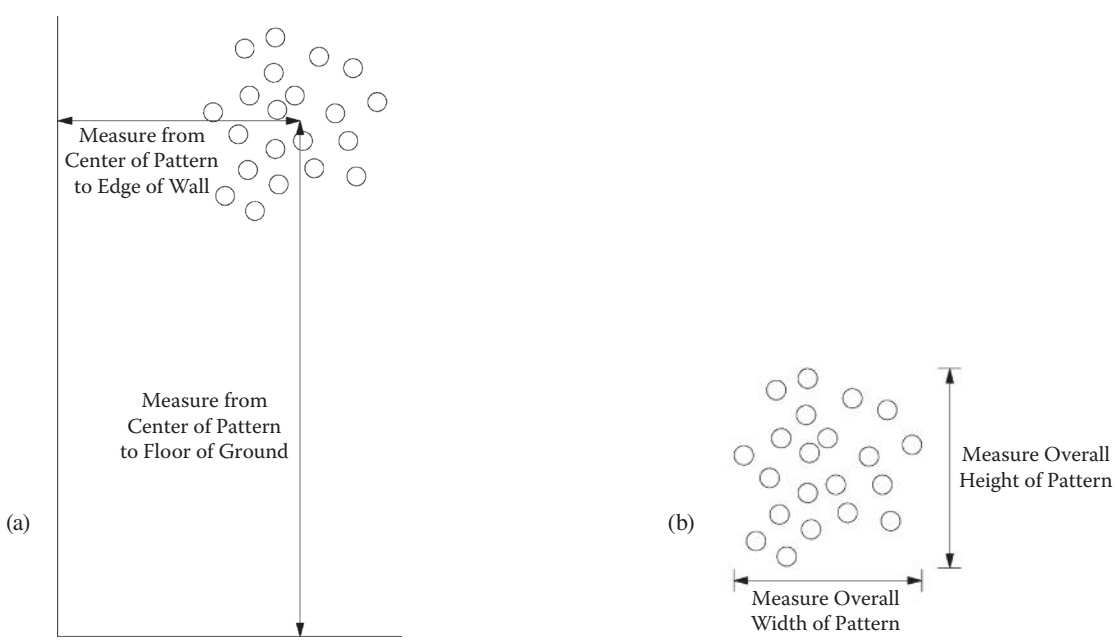
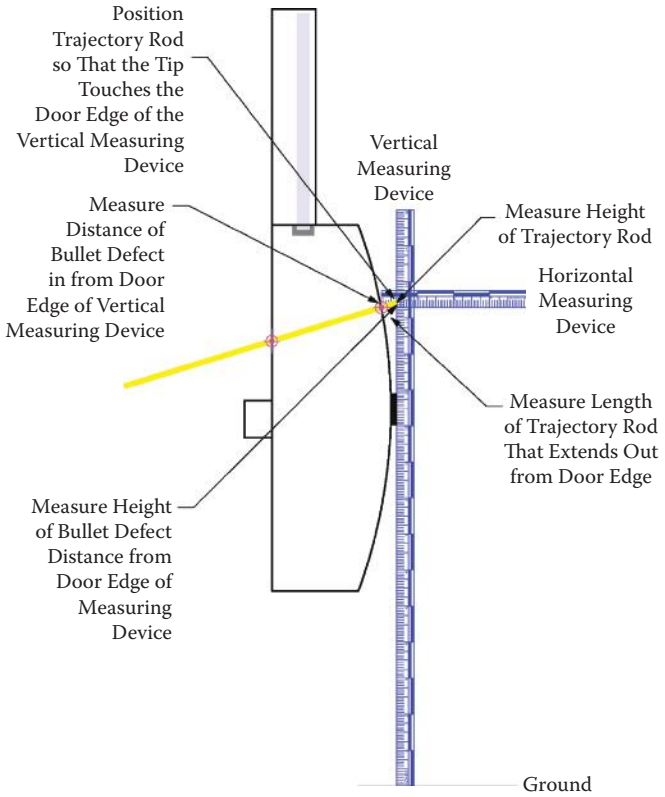
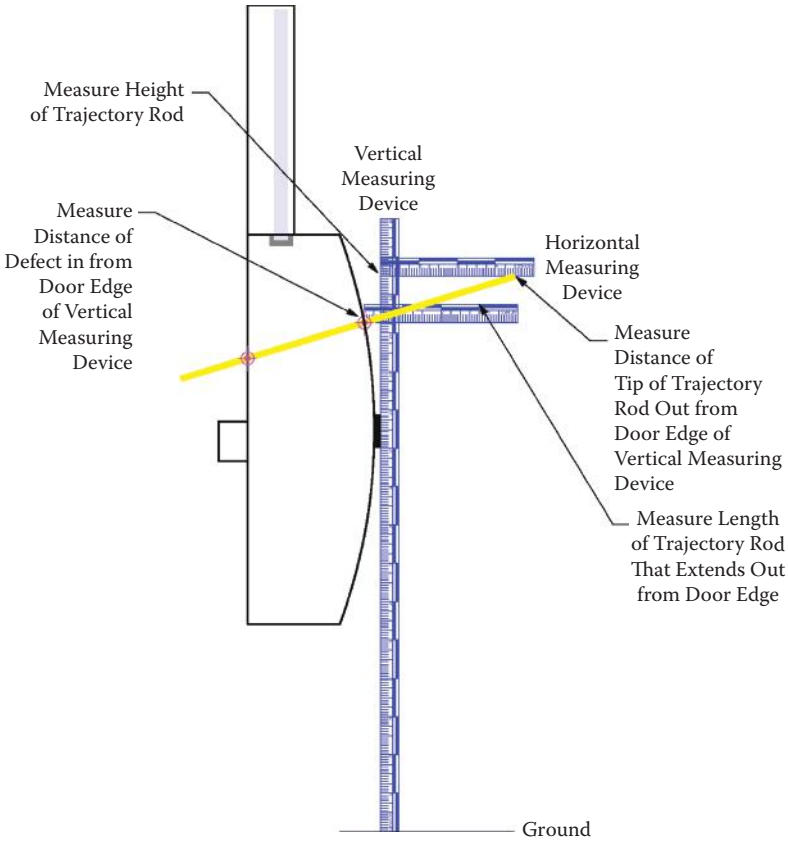


FIGURE 18.7 Illustrations demonstrate the proper method to document shotgun patterns.



(a)



(b)

FIGURE 18.8 Illustrations demonstrate the measuring techniques when using the vehicle edge reference. This tip of the trajectory rod is aligned with the edge of the vehicle, (b) the tip of the trajectory rod is positioned further out from the edge of the vehicle.

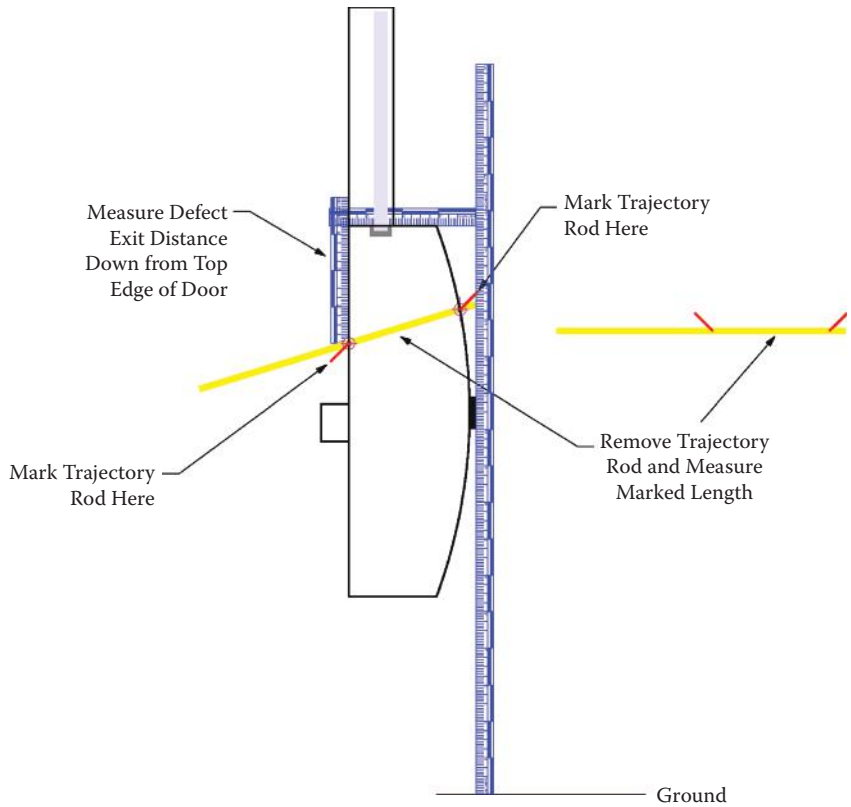


FIGURE 18.9 Illustration demonstrates the proper technique to document a bullet defect using the entrance and exit bullet defects.

Documenting Bullet Defects Using the Entrance and Exit Defects

A trajectory rod is placed in the primary bullet defect and the proper secondary bullet defect. The exit bullet defect is then measured using the primary defect as a reference point. This is done by measuring the height of the top of the door. Measure the distance from the top of the door to the secondary bullet defect's exit. Then subtract the distance the exit defect is from the distance from the top of the door to the ground. The trajectory rod is marked at the entrance of the primary defect and the exit of the secondary defect. The trajectory rod is then removed, and the distance between the marks is measured. One additional measurement will be necessary with this technique, i.e., a horizontal measurement that aids in the placement of the bullet defect on the vehicle. Figure 18.9 illustrates the measurements obtained using this particular technique.

Ricochets

These types of bullet defects are difficult to document using trajectory rods. This process can be done, but it requires the use of multiple investigators. One investigator is needed to hold the trajectory rod, and another is needed to measure the trajectory rods. This is not to be confused with a deflection. A deflection occurs at greater incident angles, and the bullet essentially bounces off the surface. The nature of the surface is critical on the ricochet angle.

FIGURE 18.10 Image demonstrates the use of trajectory rods to document a ricochet.

Placing a trajectory rod into the entrance side of the ricochet allows you to document the original angle the projectile was traveling. Placing the trajectory rod into the exit side allows you to document the angle that the projectile traveled after leaving the surface. Figure 18.10 illustrates the use of trajectory rods to measure the entrance and exit of a projectile from a ricochet.

Photography

Begin with overall photographs of the surface containing the bullet defects. Then take midrange and close-up photographs

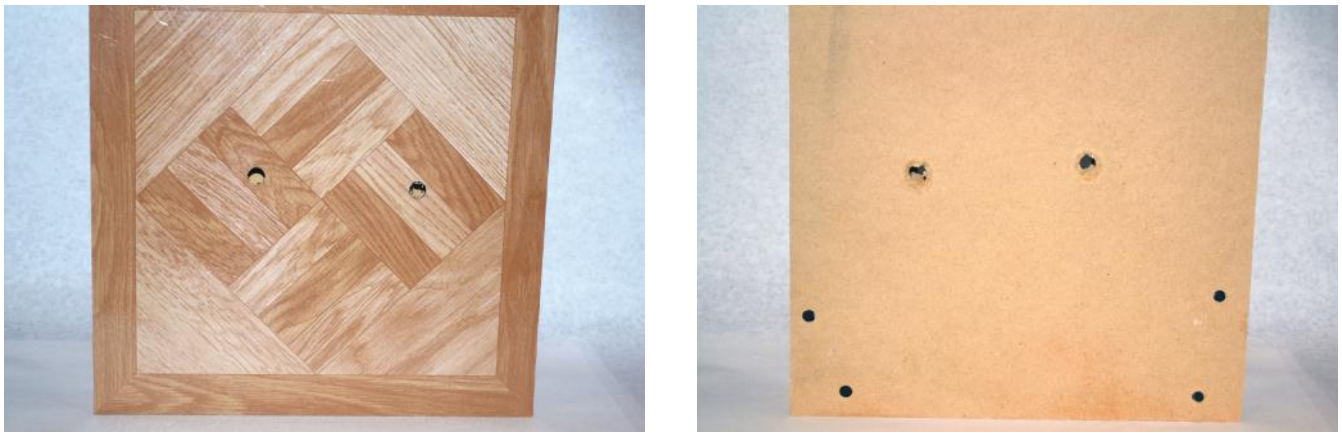


FIGURE 18.11 Images of the overall photographs for the primary and secondary bullet defects in a wall prior to the addition of scales and labels.

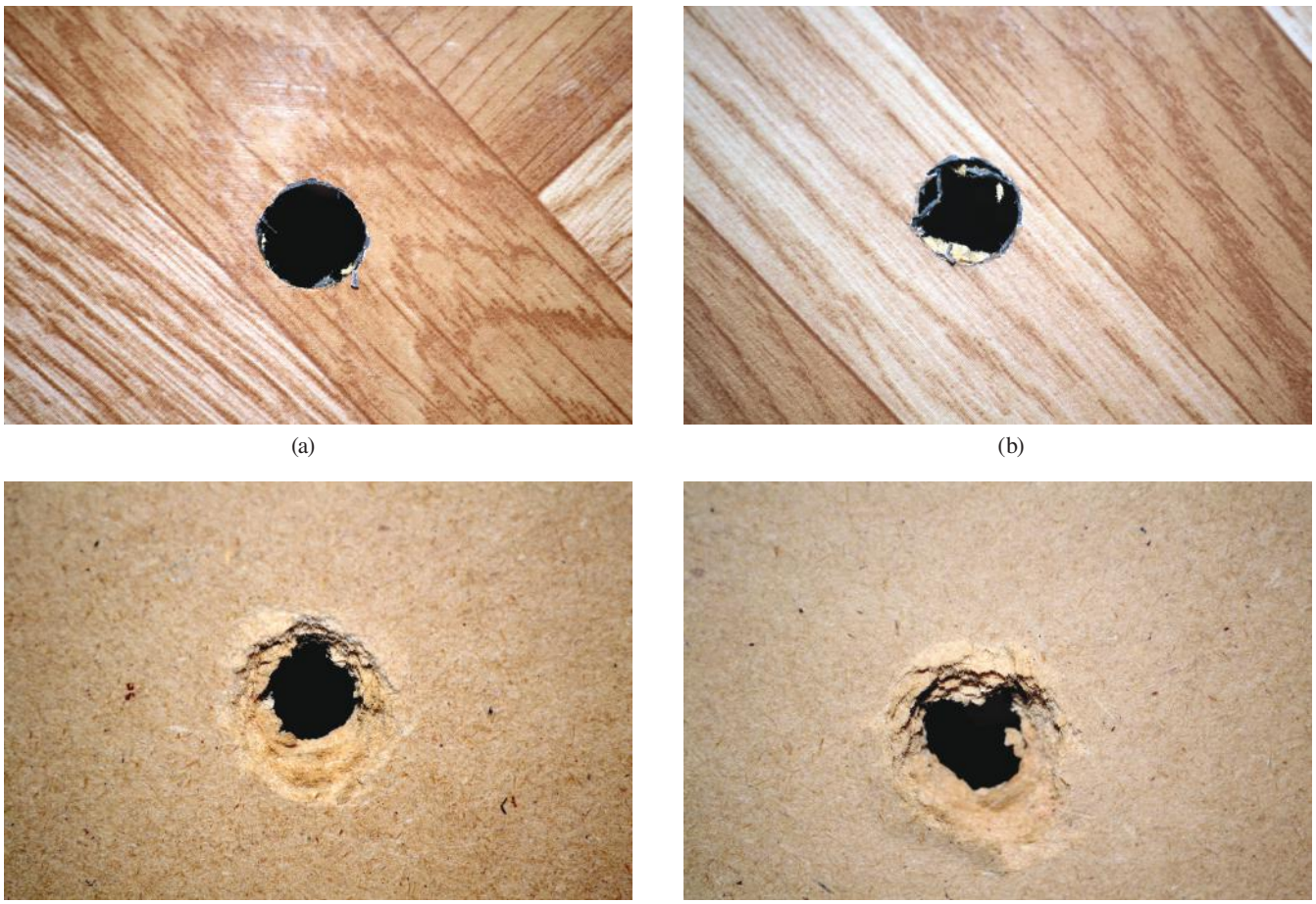


FIGURE 18.12 Illustrations of the proper close-up photographs for the primary and secondary bullet defects prior to the addition of scales and labels.

of each bullet entrance and exit defect. The concept of an overall photograph in this situation does not imply that you must start at the intersection and work your way back into the scene. Here, the overall photographs are of the entire wall or surface that contains the bullet defect (Figure 18.11).

Figure 18.12 shows examples of proper close-up photographs of primary and secondary bullet defects. These photographs are pre-scales. If the bullet defects are spread out, an additional midrange photograph for each bullet defect may be necessary. In the case of these examples, the overall photograph also serves as the midrange photograph.

Label Each Bullet Defect

The bullet defects are labeled with a scale. Another series of overall, midrange, and close-up photographs are taken. As with all midrange and close-up photographs, the first set is taken showing that nothing was added to the scene or that no additional evidence was intentionally covered up. Figure 18.13 shows images of the overall photographs of primary and secondary bullet defects after the scales have been added to the wall.

Figure 18.14 depicts proper close-up photographs of primary and secondary bullet defects. These photographs are

FIGURE 18.13 Images of the overall photographs for the primary and secondary bullet defects in a wall, after scales have been added.

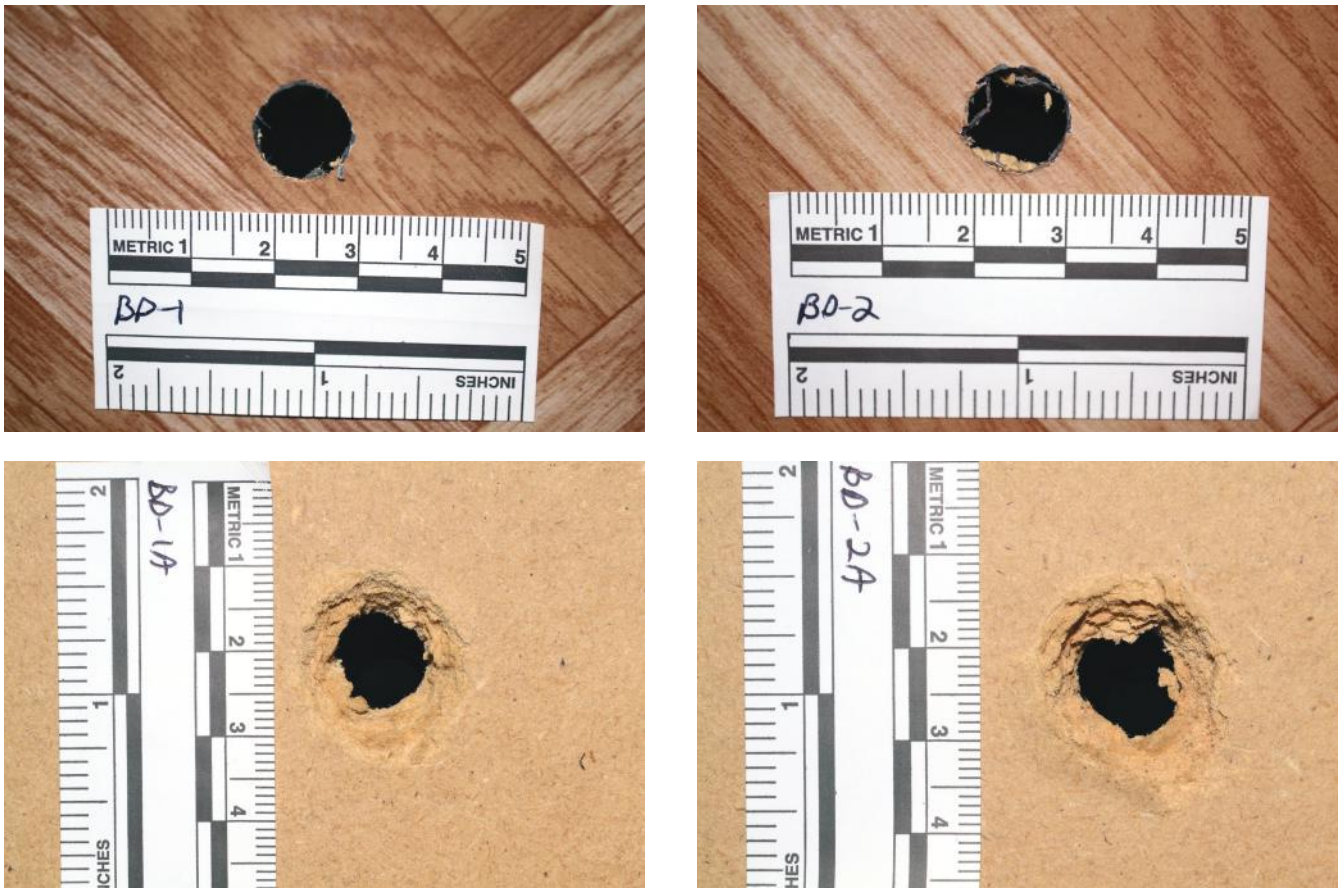


FIGURE 18.14 Illustrations of the proper close-up photographs for the primary and secondary bullet defects.

post-scales. Again, if the bullet defects are spread out, an additional midrange photograph for each bullet defect may be necessary. In these examples, the overall photograph also serves as the midrange photograph. Proper examination-quality photographs must be taken of each labeled bullet defect.

Note that proper scale placement is necessary for examination-quality photographs. One edge of the scale must be aligned with the long axis of the bullet defect.

Photographing Horizontal and Vertical Measurements

The horizontal and vertical measurements may be photographed at the same time. This technique may require multiple people to accomplish. In a small scene, it may not be possible to properly document both measurements at the same time. Figure 18.15 shows images of overall and close-up photographs of both measurements obtained at the same time. This should especially be done on vehicles. Take a door for example: What one person calls the front edge of a door may differ from what another person calls the front edge. A proper photograph of the measuring device alleviates this issue.

The measurements may also be photographed individually. This technique is especially helpful where the bullet defect is on a surface with curved edges, such as a car door, car fender, etc. Figure 18.16 shows images of overall and close-up photographs of both measurements obtained individually.

Once the trajectory rod has been properly placed in the primary and secondary defects, the trajectory rod must be documented. Figure 18.17 shows images demonstrating the proper measurements of the trajectory rod.

The protractor used to measure the azimuth angle may also be photographed. If an angle gauge and/or smart level are also used to document the angle measurements, you may also photograph these as well to show the angle measurements. It is essential that the numbering on the protractor be in focus and not the trajectory rod. An out-of-focus trajectory rod will still have a smooth edge that may be used as a

FIGURE 18.15 Images of the overall and close-up photographs of both measurements of the bullet defect obtained at the same time.

FIGURE 18.16 Images of the overall and close-up photographs of both measurements of the bullet defect obtained individually. *(continued)*

FIGURE 18.16 (continued) Images of the overall and close-up photographs of both measurements of the bullet defect obtained individually.

FIGURE 18.17 Images demonstrate the proper method to obtain the vertical angle measurements depending on how the reference line of the protractor is aligned with the trajectory rod.

measurement reference. Additional close-up photographs of the actual measured angle are also necessary unless they are visible in the midrange photograph.

Please review Figure 18.2 for the proper placement of the protractor above the trajectory rod and Figure 18.3 for the proper placement of the protractor beside the trajectory rod. Measurements of the vertical angle are made using the protractor, the angle gauge, and the smart level.

Bullet Defects in Glass

These are possibly the most difficult photographs to capture. It may be necessary to use a timed exposure or place a cover over the back of the glass. The use of oblique lighting can create shadows; therefore, you should also take photographs without oblique lighting to show that shadows are not covering or hiding something of importance.

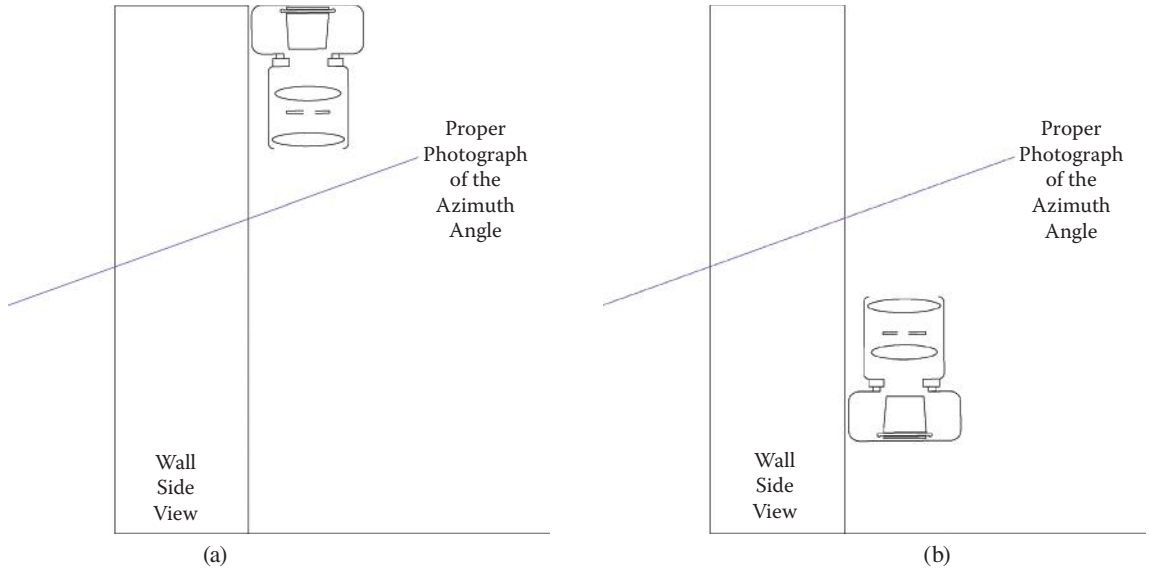


FIGURE 18.18 Illustrations of the proper placement of the camera in order to use the photograph as a measuring tool to obtain the azimuth or horizontal angle.

Photographing Bullet Defects as a Measuring Tool

Azimuth or Horizontal Angle

The camera is positioned directly above the protruding trajectory rod. The camera's image sensor or film plane must be level with the ground. For a wall, the camera may be placed against the wall. If the bullet defect and trajectory rod are too high, the camera may be positioned underneath the protruding trajectory rod.

When this technique is used, there must be some reference line, which may be the bottom edge of the wall (Figure 18.18a), the top edge of the wall, or the edge of the vehicle (Figure 18.18b). This reference line is used to determine the angle. A protractor may be placed over the photograph of the trajectory rod protruding from the wall, making the azimuth angle easy to read. Align the protractor's zero edge along the bottom or top of the surface containing the bullet defect. Reposition the protractor's reference mark onto the trajectory rod and measure the angle.

Vertical Angle

The camera should not be parallel to the surface containing the bullet defect and should not be perpendicular to the surface. The camera should be perpendicular to the protruding trajectory rod. Figures 18.19a and 18.19b indicate improper camera placement. The camera cannot be placed such that the camera lens is parallel to the floor or ground (Figure 18.19b) or the camera lens is perpendicular to the surface containing the bullet defect (Figure 18.19b). Both of these measurements result in an inaccurate measurement of the vertical angle.

The only method where the correct measurement can be obtained is to place the camera such that the lens is perpendicular to the trajectory rod and the base of the camera is parallel to the floor or ground. The photograph may be printed out and a protractor used to obtain the measurement, or a drawing program may be used to place a protractor appropriately over the trajectory rod. In this case, the horizontal plane becomes the reference line. Align the protractor's zero edge with the bottom edge of the photograph. Reposition the protractor's reference mark onto the trajectory rod and measure the angle.

Forms

Figure 18.20 illustrates the proper measurements to document a vehicle that has been shot.

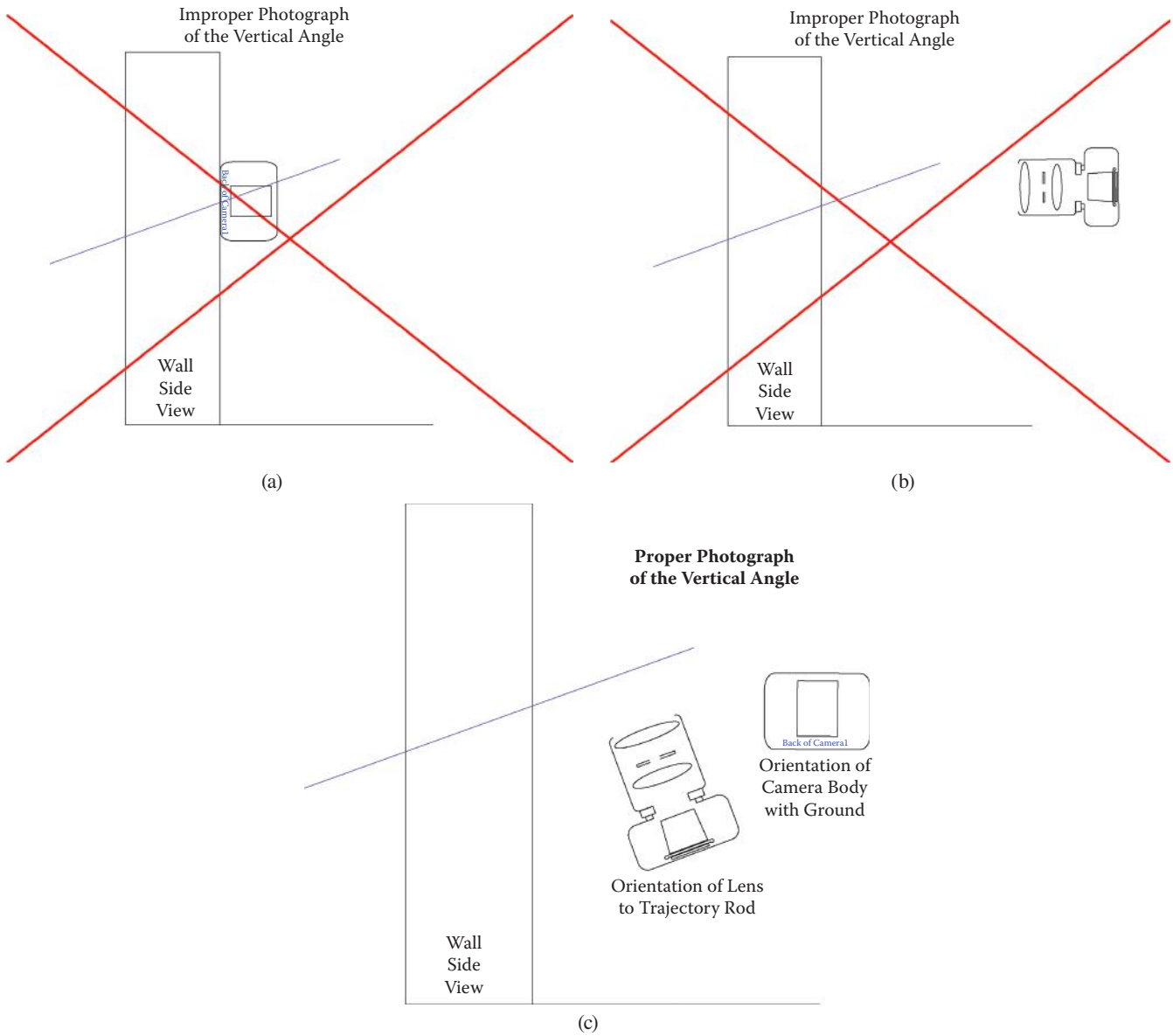


FIGURE 18.19 Illustrations of the proper and improper placement of the camera in order to use the photograph as a measuring tool to obtain the vertical angle.

Shooting Vehicle Documentation – Car Measurements

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident	Date of Crime:	Date Processed:

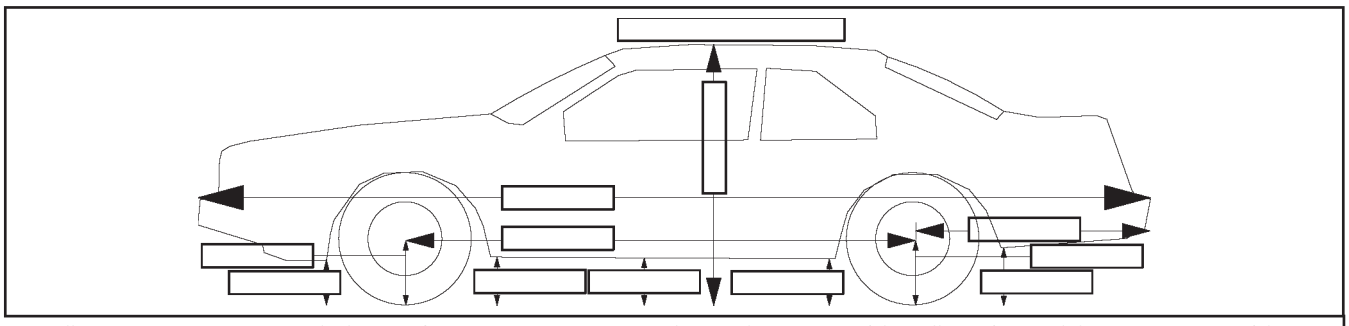
Location Processed:	Date/Time of request:	Arrival Time:	Departure Time:	☐ Warrant	☐ Waiver	☐ None

Detectives	Detectives Present:	☐ Yes	☐ No	Vehicle:	☐ Suspect	☐ Victim	☐ Stolen	☐ Other

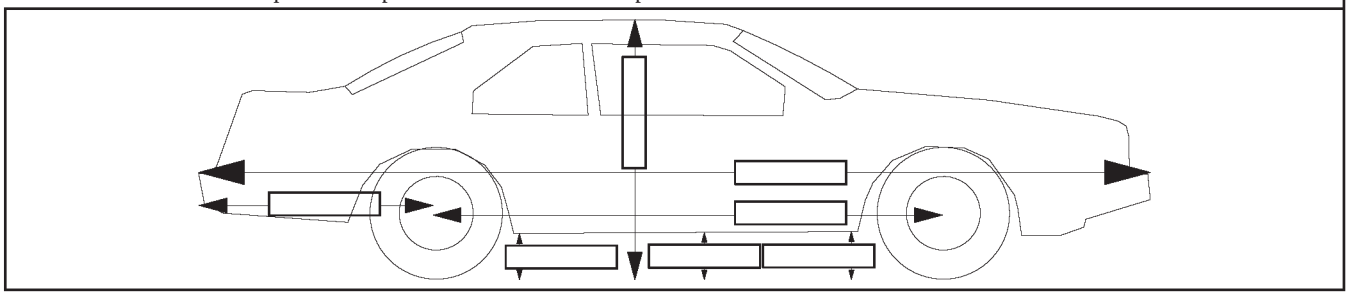
Type of Processing Requested:

Year:	Make:	Model:	No Doors:	Color:	Tag:	Tag Mo./Yr.:	State:

Decal No.:	VIN:	Sealed:	☐ Yes	☐ No	Date Sealed:	Initialed:	☐ Yes	☐ No	Initials:



Not All Measurements are Required. The Specific Measurements are Dependent on the Location of the Bullet Defects and the Circumstances of the Case

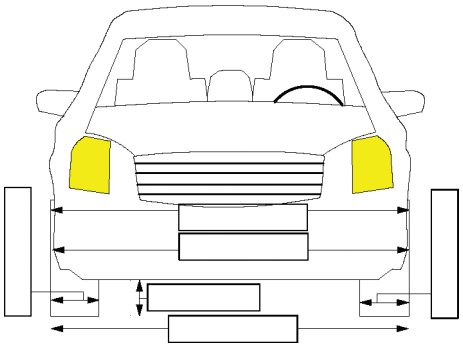


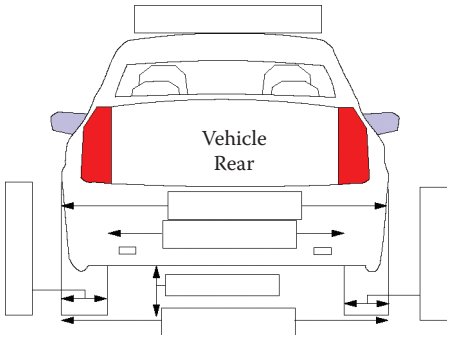
Not All Measurements are Required. The Specific Measurements are Dependent on the Location of the Bullet Defects and the Circumstances of the Case

Notes/Additional Information:

FIGURE 18.20 This form illustrates the proper measurements to document a vehicle. This is the first page of the form. *(continued)*

Shooting Vehicle Documentation – Car Measurements





Notes/Additional Information:

Driver Side Tires

Front:	Brand:	Size:	DOT No.:	Pressure:	PSI	MAX PSI
Rear:	Brand:	Size:	DOT No.:	Pressure	PSI	MAX PSI

Passenger Side Tires

Front:	Brand:	Size:	DOT No.:	Pressure:	PSI	MAX PSI
Rear:	Brand:	Size:	DOT No.:	Pressure:	PSI	MAX PSI

Engine Type:	Transmission Type:	Wheel Drive Type:	☐ Front	☐ Rear	☐ All

Height Changes With Occupant Loading:

Load (Weight):	Height of Vehicle Body Above Ground – Driver Side:
Load (Weight):	Height of Vehicle Body Above Ground – Passenger Side:

For Vehicles Struck at Rest and NOT Subsequently Moved:

Position of Shifting Lever:	Height of Vehicle Body Above Ground – Driver Side:

FIGURE 18.20 (continued) This form illustrates the proper measurements to document a vehicle.

EXERCISES

Equipment for exercises

- 12 × 12-in. wall with three bullet entrance holes and corresponding exit holes
- Two measuring tapes
- 3 or 6-cm stick-on tapes
- Notepad and pen or pencil
- Three dowel rods
- 6-in. transparent rule
- 12-in. rule
- Scientific calculator with trigonometric ratios
- Protractor
- Smart level
- Angle finder
- String
- Protractor with attached laser
- Thumbtacks
- Scotch tape
- Tripod

EXERCISE 18.1

Bullet Defect Documentation: Walls/Buildings

Initial Documentation of Bullet Defect

BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								

Bullet Defect Documentation: Vehicles

Initial Documentation of Bullet Defect

BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								
BD -	Height of Defect:	Horizontal Defect Measurement:	Height of Trajectory Rod:	Horizontal Trajectory Rod Measurement:	Trajectory Rod Length:	Protractor Angle:	Angle Gauge:	Smart Level:
Notes:								

PHOTO EXERCISE 4.26A

Bullet Defect: Wall

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Build a small-scale wall.
2. Shoot several bullet defects into the small-scale walls.
3. Place the camera on a tripod.
4. Adjust the camera to aperture priority mode.
5. Set the aperture to f/11.
6. Position the camera over the bullet defect such that the defect is positioned in a landscape format.
7. Be sure to use the appropriate scale and scale placement when photographing.

Bullet Defect:

1. Photograph bullet defect(s).
2. Photograph bullet defects with scales.
3. Photograph the appropriate measurements of each bullet defect.
   a. Horizontal measurement
   b. Vertical measurement
4. Photograph the trajectory rod in each bullet defect.
5. Photograph the appropriate measurements of the trajectory rod.
   a. Horizontal measurement
   b. Vertical measurement
   c. Protractor horizontal measurement
   d. Protractor vertical measurement
   e. Angle gauge
   f. Smart level
6. Photograph bullet defect using photography as the measuring tool.
   a. Horizontal angle
   b. Vertical angle

PHOTO EXERCISE 4.26B

Bullet Defect: Glass

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/5.6	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Shoot a piece of plate glass.
2. Place the camera on a tripod.
3. Adjust the camera to aperture priority mode.
4. Set the aperture to f/5.6.
5. The aperture may need to be adjusted to narrow the depth of field to just the glass.
6. Position the camera over the bullet defect so that the bullet defect is positioned in a landscape format.
   a. Photograph bullet defect(s) in glass.
   b. Photographs bullet defects with scales.
7. Be sure to use the appropriate scale and scale placement when photographing.

PHOTO EXERCISE 4.26C

Using Photographs as a Measuring Tool

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/5.6	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Use the small-scale wall from Photo Exercise 4.28a.
2. Properly place the trajectory rod in the appropriate bullet defects.

Vertical Angle:

1. Adjust the camera to aperture-priority mode.
2. Set the aperture to f/5.6.
3. The aperture may need to be adjusted to narrow the depth of field to just the glass.
4. Position the camera above the wall, pointing the lens down.
5. Ensure that the base of the camera is parallel to the wall surface.
6. Ensure that the bottom edge of the wall is visible in the viewfinder.
7. Take the photograph.

Horizontal Angle:

1. Place the camera on a tripod. Ensure that the base of the camera is parallel to the ground or the floor.
2. Adjust the camera to aperture-priority mode.
3. Set the aperture to f/5.6.
4. Position the camera so that the lens is perpendicular to the trajectory rod.
5. Take the photograph.

19 Exercises for Bloodstain Documentation

PROPER DOCUMENTATION OF BLOODSTAINS

Proper documentation of bloodstains assists in developing the scenario under which the stains were created. The scientific principles that apply to fluids also apply to bloodstains such as

1. Surface tension
2. Viscosity
3. Gravity
4. Laws of physics

Once a blood droplet becomes airborne, it retains its spherical shape due to molecular bonding and surface tension. A well-formed stain is divided along its long axis, is approximately equal on both halves. Bloodstains that are well formed are beneficial in the analysis process. A circular stain indicates that the blood droplet struck the surface at a 90° angle. Elliptical stains are evidence that the blood struck the surface at an angle smaller than 90°. Blood does not travel in a straight line; rather, it travels in a parabolic arc. However, the use of straight-line geometry is applicable to mathematically determine the angle at which the blood droplet struck the surface. A typical experiment performed in the basic bloodstain class is dropping blood droplets onto surfaces at known angles.

BLOODSTAIN TERMINOLOGY

Knowing the proper terminology aids the investigator in recognizing and documenting certain bloodstains or stain patterns. SWGSTAIN (Scientific Working Group on Bloodstain Pattern Analysis) has recommended terminology. It is the only SWG that is not currently under the direction of the FBI. The International Association of Bloodstain Pattern Analysis (IABPA) has also adopted this terminology.

Accompanying drop: A small blood drop produced as a by-product of a drop formation.

Altered stain: A bloodstain with characteristics that indicate a physical change has occurred.

Angle of impact: The acute angle (alpha) relative to the plane of a target at which a blood drop strikes the target. This assists in the concept of straight-line geometry.

Area of coverage: The area containing the intersections generated by lines drawn through the long axis of the individual stains. This area indicates the location of the blood source in two dimensions.

Area of origin: A three-dimensional area in space where the blood spatter originated.

Back-spatter pattern: A bloodstain pattern resulting from blood drops that traveled in the opposite direction of the external force applied. It is associated with an entrance wound created by a projectile.

Blood clot: A gelatinous mass formed by a complex mechanism involving red blood cells, fibrinogen, platelets, and other clotting factors.

Bloodstain: A deposit of blood on a surface.

Bloodstain pattern: A grouping or distribution of bloodstains that indicates—through regular or repetitive form, order, or arrangement—the manner in which the pattern was deposited.

Bubble ring: An outline within a bloodstain resulting from air in the blood.

Cast-off pattern: A bloodstain pattern resulting from blood drops released from an object due to its motion. Patterns created when blood is flung or projected from an object in motion or when that motion suddenly stops.

Cessation cast-off pattern: A bloodstain pattern resulting from blood drops released from an object due to its rapid deceleration.

Directionality: Characteristics of a bloodstain that indicate the direction blood was moving at the time of deposition.

Directionality angle: The angle (gamma) between the long axis of the spatter and a defined reference line on the target.

Drip pattern: A bloodstain pattern resulting from a liquid that dripped into another liquid, at least one of which was blood.

Drip stain: A bloodstain resulting from a falling drop that formed due to gravity.

Drip trail: A bloodstain pattern resulting from the movement of a source of drip stains between two points

Edge characteristics: A physical feature of the periphery of a bloodstain.

Expiration pattern: A bloodstain pattern resulting from blood forced by airflow out the nose, mouth, or a wound.

Flow patterns: Bloodstain patterns resulting from the movement of a volume of blood on a surface due to gravity or movement of the target.

Forward spatter pattern: A bloodstain pattern resulting from blood drops that traveled in the same direction as the impact force.

Impact pattern: A bloodstain pattern resulting from an object striking liquid blood.

Insect stain: A bloodstain resulting from insect activity.

Mist pattern: A bloodstain pattern resulting from blood reduced to a spray of microdrops as a result of the force applied.
Parent stain: A bloodstain from which a satellite stain originated.
Perimeter stain: An altered stain that consists of the peripheral characteristics of the original stain.
Pool: A bloodstain resulting from an accumulation of liquid blood on a surface.
Projected blood: Blood spatter as characterized by blood striking a target under pressure.
Satellite stain: A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface.
Saturation stain: A bloodstain resulting from the accumulation of liquid blood in an absorbent material.
Serum stain: A stain resulting from the liquid portion of blood (serum) that separates during coagulation.
Spatter stain: Bloodstain resulting from a blood drop dispersed through the air due to an external force applied to a source of liquid blood.
Splash: A bloodstain pattern resulting from a volume of liquid blood that falls or spills onto a surface.
Swipe pattern: A bloodstain pattern resulting from the transfer of blood from a blood-bearing surface onto another surface, the characteristics of which indicate relative motion between the two surfaces.
Target surface: A surface onto which blood has been deposited.
Transfer stain: A bloodstain resulting from contact between a blood-bearing surface onto another surface.
Void: An absence of blood in an otherwise continuous bloodstain or bloodstain pattern.
Wipe: An altered bloodstain pattern resulting from an object moving through a preexisting wet bloodstain.

ADDITIONAL TERMS TO BE AWARE OF

Arterial gushing/spurt: The escape of blood under pressure, typically from a breached artery or heart, showing pressure, pressure fluctuations, or both.
Blowback effect: The process in which blood is deposited inside the barrel of a firearm after discharge.
Capillary action: The force exhibited in the attraction of a liquid to surfaces with which it is in contact and its own surface tension.
Contact stain: Any stain or pattern created by the transfer of blood from one object to another through physical contact.
Direction of flight: The trajectory of a blood drop, which can be established by its angle of impact and directional angle.
Expectorate spatter/blood: Spatter created when blood is forced from the mouth, nose, or respiratory system under pressure.
Flight path: The path of the blood drop as it moves through space from the impact site to the target.
Flow: The movement of liquid blood as a mass under the effects of gravity.
Impact site: The point where a given force encounters a blood source.
Leading edge: The area where the blood droplet first makes contact with the target surface.
Nonspatter stains: Any stains or patterns other than those defined by the spatter group and not composed of small circular or elliptical stains.
Passive drop: Bloodstain drops created or formed by the force of gravity acting alone.
Pattern transfer: A pattern created by the transfer of blood from one object to another in which a recognizable characteristic or image is present in the patterns.
Primary stain: The main stain found in any pattern.
Ricochet: A bloodstain that is created when a blood droplet impacts with another surface before striking the final target surface.
Skeletonized stain/skeletonization: A bloodstain that (although disturbed) still reflects its original shape and size.
Smear: Any stain or pattern created by the transfer of blood from one object onto another through some form of contact involving lateral motion.
Spines: The pointed edges of a stain that radiates out from the spatter.
Wave castoff: A small amount of blood that originates from a parent drop of blood due to the wavelike action of the liquid in conjunction with a striking surface.

PHOTO DOCUMENTATION TECHNIQUE FOR BLOODSTAINS

Initial Overall, Midrange, and Close-Up Photographs

Begin with the overall photographs of the surface containing the bloodstains (Figure 19.1). Photograph all pattern transfers, flows, and spatter patterns. Midrange photographs are then taken of the spatter patterns. These midrange photographs must be at a 90º angle to the surface containing the bloodstains. Various stains within the pattern should also be photographed with close-up photographs. In this technique, each pattern is sequentially labeled with a letter. Within each pattern, individual stains are numbered sequentially. Begin by examining the overall surface containing the bloodstains.

Visually examine the stains to see if there are associated patterns. In this step, you attempt to determine the number of occurrences that are present on the surface. One technique to distinguish various patterns is to visually draw lines through the long axes of several of the stains (Figure 19.2). As crime scene investigators, we would not physically draw lines through any bloodstains. Visually drawing the lines is a task that takes time and practice. However, this is a task that you

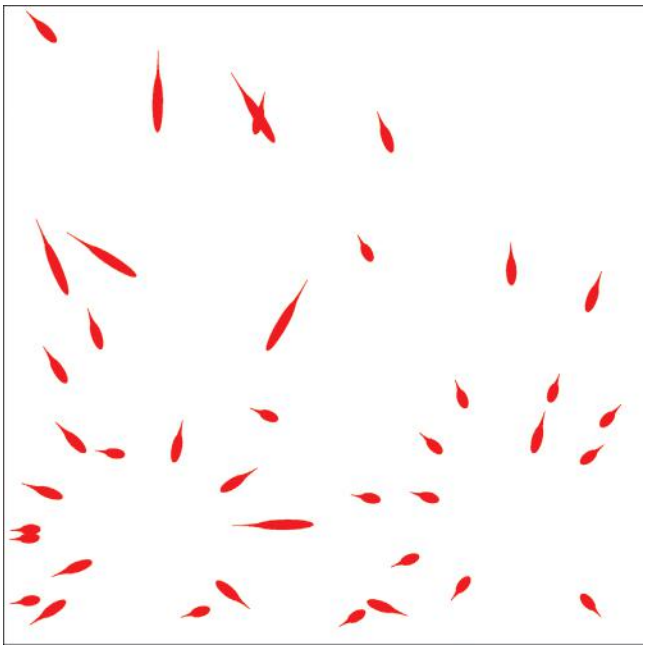


FIGURE 19.1 Illustration of an overall documentation of blood spatter on a wall.

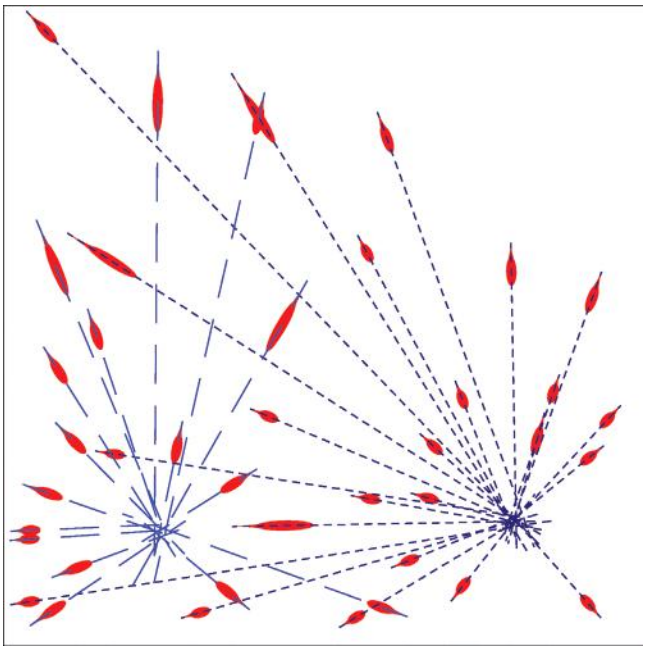


FIGURE 19.2 Illustration demonstrates the area of convergence.

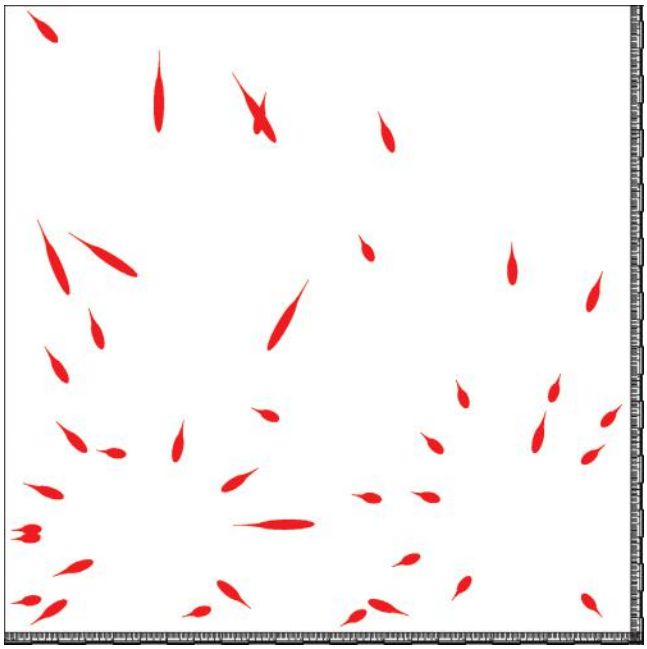


FIGURE 19.3 Illustration of the proper placement of horizontal and vertical measuring devices near a blood-spatter pattern.

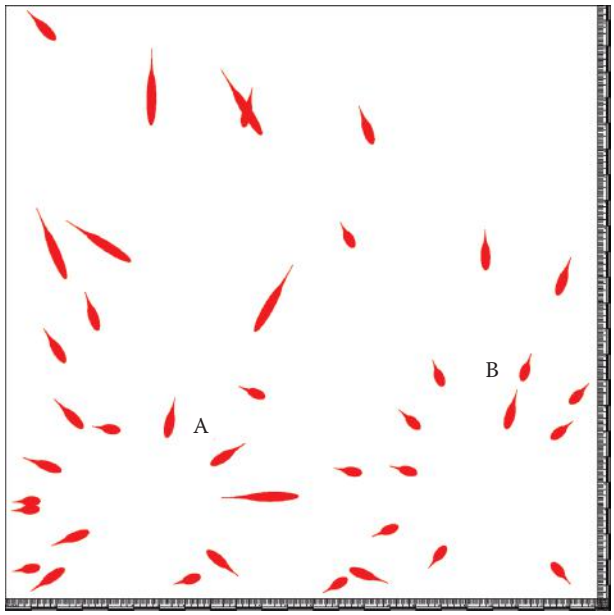


FIGURE 19.4 Illustration of the proper placement of an alpha label for each blood-spatter pattern.

must accomplish if you want to be successful in documenting bloodstains and bloodstain patterns.

Label Individual Spatter Patterns

The next step is to place a measuring system along the horizontal and vertical sides of the stains. These may include steel tape measures or specialized scales (Figure 19.3). The scales must be flat against the wall and be level vertically and horizontally. Each pattern or occurrence is then labeled alphabetically (Figure 19.4). If there were five spatter patterns, the identifiers would be A, B, C, D, and E.

Label Individual Stains within Each Spatter Pattern

Within each spatter pattern, select a minimum of four well-formed stains. These stains should be from throughout the pattern and not just in a single area. These bloodstains are

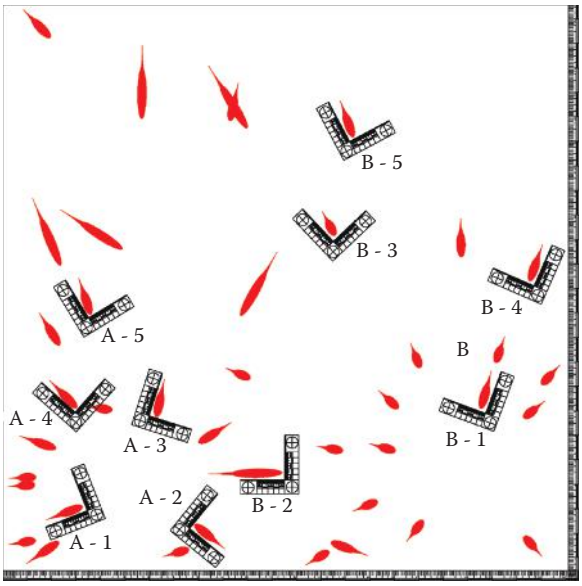


FIGURE 19.5 Illustration of a properly documented wall containing bloodstain patterns.

labeled with alphanumeric identifiers such as A1, A2, A3, B1, etc. (Figure 19.5).

Overall Photographs, Second Set

Once each pattern and each stain has properly been labeled, an overall photograph is again taken. Ideally the letter identifications for the patterns as well as the stain numbering should be visible in this photograph. If this is not possible, several overlapping midrange photographs of the area must be taken. Next, take a midrange photograph of pattern A, followed by pattern B, then pattern C, etc.

Examination-Quality Photographs

Take close-up photographs of each stain (i.e., A1, A2, etc.) within pattern A. Repeat this process for each pattern and the individual stains within that pattern until all the patterns have been photographed. The final series consists of examination-quality photographs of each of the individually labeled stains.

A vertical line should be placed on each scale. The use of a torpedo level or an angle gauge in a trajectory kit will work well. The vertical line is used by the BackTrack computer program to define the gamma angle.

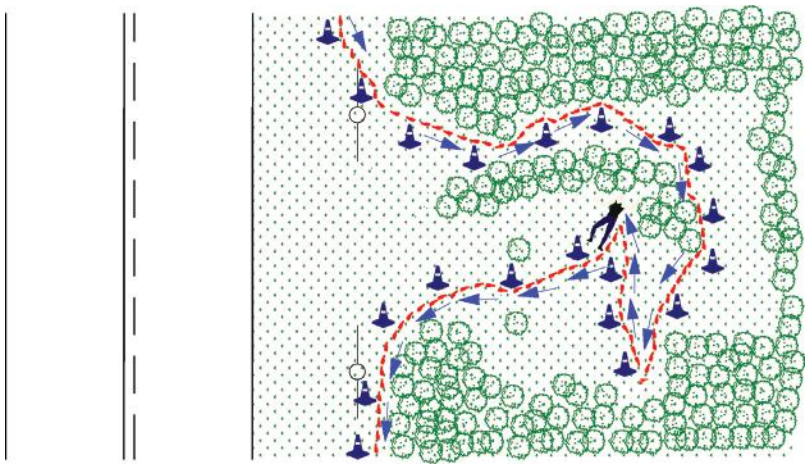


FIGURE 19.6 This is an illustration of the proper cone placement and process to photograph a trail.

EXERCISES

EXERCISE 19.1

Write a description of the stains.

PHOTOGRAPHING A TRAIL

Documenting a footwear impression trail or bloodstain trail may show little more than the terrain. Place cones along the path and photograph the overall path of the cones. Photograph the cones as you progress from one end of the trail to the other.

PHOTO EXERCISE 4.27

Documenting a Trail

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Normal Lens

Directions:

1. This exercise will mimic a blood train or footwear trail that is not visible in the overall crime scene photographs.
2. The cones are used to visually identify the locations of the evidence.
3. Place several cones along a trail from a room into the hallway.
4. Take the appropriate overall, midrange, and close-up photographs of the cones along the trail.
5. Place evidence markers next to each evidence item.
6. Repeat the process while taking the appropriate overall, midrange, and close-up photographs of the cones along the trail with the evidence markers.
7. Repeat this exercise for an exterior trail.
8. Repeat this exercise during the night or low-light situations.

PHOTO EXERCISE 4.28A

Blood Spatter on Wall

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Place the camera on a tripod.
2. Adjust the camera to program aperture priority mode.
3. Set the aperture to f/11.
4. Place several bloodstain patterns on a wall or attach (tape) paper containing bloodstain patterns to the wall.
   a. Photograph the blood spatter in overall condition.
   b. Photograph the individual stain patterns.
   c. Photograph individual stains within each pattern.
   d. Photograph the overall area after the appropriate markers have been put in place.
   e. Photograph the individually labeled stain patterns.
   f. Produce examination-quality photographs of the individual stains.
5. Be sure to use the appropriate scale and scale placement when photographing.

PHOTO EXERCISE 4.28B

Blood Spatter on Clothing

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:
General Photography:

1. Place blood spatter on several clothing items.
2. Place the appropriate length and width scales.
3. Place the camera on a tripod.
4. Adjust the camera to aperture-priority mode.
5. Set the aperture to f/11.
6. Position the camera over the bullet defect so that the defect is positioned in a landscape format.
7. Photograph the overall clothing item.
8. Place an L scale appropriately next to the individual spatters.
9. Take the appropriate midrange and close-up photograph of the blood spatter.
10. Take the appropriate examination-quality photograph of the blood spatter.

Reinforcement Circles:

1. Using circular reinforcement tabs, place the circles around blood spatter on a dark clothing article.
2. Place the appropriate length and width scales.
3. Place the camera on a tripod.
4. Adjust the camera to aperture-priority mode.
5. Set the aperture to f/11.
6. Position the camera over the bullet defect so that the defect is positioned in a landscape format.
7. Photograph the overall clothing item.
8. Place an L scale appropriately next to the individual spatters.
9. Take the appropriate midrange and close-up photograph of the blood spatter.
10. Take the appropriate examination-quality photograph of the blood spatter.

20 Exercises for Identifying Clandestine Graves and Scattered Human Remains

FORENSIC BOTANY

What type of plant material are we dealing with? Where do the plants typically grow? Are the plants growing (a) all over, (b) in specific regions, or (c) in a specific area?

The digging of a grave disrupts the immediate botanical environment. When a botanical environment is disturbed, the first plant to return is a *pioneer plant*. These plants are not generally growing in the surrounding area. Forensic botanists may be able to determine how old a root is, especially if it is growing into the grave. The plant's age will be as young as or younger than the grave. In this manner, a forensic botanist may use the botanical evidence to estimate the postmortem interval.

The principles of evidence collection favor collecting the entire plant. If this is not possible, collect the top 10–12 in., which includes any flowers, fruits, seeds, or buds. Package the collected botanical evidence in paper sacks and ensure that any soil in the sample is dry.

FORENSIC ENTOMOLOGY

Entomology is the study of insects; forensic entomology is the study of insects and their anthropoid counterparts in legal matters. The medicolegal branches deal with civil to criminal areas, including child-neglect cases, food infestations (e.g., was the insect there prior to purchase or after purchase?), and housing infestations (e.g., did the home seller have information that infestation was a preexisting condition?).

Postmortem Interval (PMI)

The period of isolation (POI) is the time period between death and colonization of the corpse by insects. The time of colonization (TOC) is the time frame based on the larval age of the insects in and around the corpse. The postmortem interval is important because it provides a time frame that narrows the scope of the database search for missing individuals. It may also be useful in establishing a suspect's whereabouts during the identified time frame.

GEOLOGY

Geology is the study of the Earth and, more specifically, the study of earth materials and earth processes. Forensic geologists apply the principles and methodology of Earth science to concerns of both civil and criminal law. They search for changes within the environment that are indirectly caused by the burial. These include soil compaction, subsidence, soil moisture, stratigraphic disturbances, superposition, desiccation, and decomposition gases.

Hydrogeology

Hydrogeology is the interdisciplinary subject of geology that studies the distribution, movement, and quality of groundwater in the soil and rocks.

Soil Compaction

Normal movement over soil causes it to compact rather uniformly. Noncompacted soil has large pores that allow water drainage and facilitate plant growth. Compacted soil has fewer pores, which affects water drainage to the area. A grave that is dug is initially uncompacted, resulting in a mound. Over time, this area becomes compacted, resulting in a depressed area.

Subsidence

Subsidence describes the local movement of an earthen surface. It is either an uplift or a downshift. In a clandestine grave, one will see a downshift as the body decomposes. Subsidence may be caused by natural factors, which includes fault-induced movement, and human-caused factors, such as coal mining, city water systems causing sinkholes, etc. Visual examinations may reveal nothing, and a LIDAR (Light Detection and Ranging) device may be needed.

Soil Moisture

Undisturbed soil has a uniform soil moisture content. A clandestine grave disturbs this uniform moisture content. This soil moisture now differs from the surrounding areas.

Stratigraphic Discontinuities

Soil has many layers called *horizons*. The O horizon is the top layer, consisting mostly of decomposed organic matter. The A horizon is the topsoil layer. The B horizon is the subsoil layer. The C horizon is the broken up bedrock. The R horizon is the unweathered rock and bedrock.

Superposition

Superposition deals with soil layers and what came first. For example, the footwear impression in the bottom of

grave came before the body, the knife followed the footwear impression, followed by the body or the casing.

Using Soil-Coring Tool/Soil Probes

These tools may be useful in examining the various soil layers around a suspected grave. A soil probe is a ½-in.-diameter steel rod. It may be used to identify areas of compacted and uncompacted soil. Slowly insert the probe into the soil, feeling for resistance and feeling the pressure necessary to push the probe into the soil. It is used before the coring tool. The coring tool takes small representative samples of the soil. It is used in the same manner as a soil probe.

SEARCH FOR THE GRAVE

The search begins with gathering information about the case. This information should include whether the body was buried or simply dumped, the total number of graves, the total number of bodies in the grave, how the victim was killed, where the victim was killed, how the body was positioned in the grave, the time of year (exact is always best) the body was buried, etc. If more than one grave is suspected, each *must* be handled separately and one at a time.

Initial Search

The initial search should be done from an airplane or helicopter. This is the least-intrusive search that can be conducted. If this is not a possibility, the initial search is done on foot. These searches are labor intensive and must be very well coordinated to be successful. If the searchers are not paying attention, evidence may be damaged or lost or, worse, the grave may be walked over and left unnoticed. Because of this, the searchers must have at least some basic training and knowledge of clandestine graves. These searches are weather dependent. They are less favorable during rainy weather. For a review of the various searching patterns, please see Chapter 6, Searching.

Documenting the Scene

The documentation of the circumstances surrounding the death—such as when the victim was last seen alive, when the victim was reported missing, etc.—must be thoroughly documented. Once the death scene has been located, it becomes necessary to document the type of area where the body was located, the exposure of the body to the sun and/or shade, whether or not there were any aquatic surroundings nearby, and the actual state of decomposition of the body.

It is just as important to document the general case information, the circumstances surrounding the death, as well as evidence of any animal scavengers in the area. Different animals carry the scavenged materials different distances. Knowing the animals native to the area assists in determining how large a search area you must cover. (See Form 20.1.)

The proper documentation and collection of entomology evidence is one task that is very important. An entomologist will examine the evidence and be able to determine a postmortem interval. This postmortem interval is very closely related to the insect data that is collected. Haphazardly documented and collected entomology evidence may ultimately make the postmortem interval to be of little or no value to the investigation. This includes insects collected at the scene or at the morgue prior to and/or during the autopsy. (See Form 20.2.)

Anytime there are insects collected, it is always good to either prepare a sketch or have one on a preprinted form so that the location of the evidence collected may be easily documented. Written descriptions are good, but what an osteologist calls one body part, the lay person may call it something different. By using a preformatted body sketch, you can simply avoid this by placing an X or specimen number on the body where the sample was collected. (See Form 20.3.)

The temperature data is one that must be documented for not only the time when the insects were being collected, but for several days following the exhumation or scene processing (for scattered remains). The temperature data is also utilized by the entomologist to assist in determining the postmortem interval. The more temperature data that is collected, the more useful the information is to the entomologist. (See Form 20.4.)

Once the investigator receives information of a possible buried body, there are certain steps and processes that should first be undertaken in an effort to scientifically locate the possible clandestine grave. Once a possible location has been found, one cannot just jump in and dig up the body. The scene must be documented, and a very slow and methodological exhumation of the grave must occur. This process generally takes no less than 8 hours and often takes several days to complete.

Some may argue that the process is unnecessary if the suspect has confessed. I disagree with that stance. There are times where the suspect may withdraw their confession, withdraw the plea deal, or appeal the case. If any of these instances are successful, then all of the possible evidence that would have been collected becomes useless simply because you chose not to process the scene correctly in the first place. (See Form 20.5.)

Forensic Entomology Larvae Collection Form General Information

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:		Date of Collection:
Specimens Collected By:		Agency:	State:	Country:

Decedent Information:

☐ Male	☐ Female	D.O.B.:	Last Seen Alive:	Date and Time Reported Missing:	Date and Time Found:	Date and Time Removed from Scene:

Type of Crime/Incident:

☐ Homicide	☐ Suicide	☐ Natural	☐ Accidental	☐ Unknown

Scene Description/Additional Information:

Death Scene Area:

Sun:	☐ Full	☐ Party Cloudy	☐ None	Clouds:	☐ Completely	☐ Mostly	☐ Partly	☐ Scattered	☐ None
Rain:	☐ Heavy	☐ Light	☐ None	Approx 24h Total:	Snow	☐ Heavy	☐ Light	☐ None	Approx 24h Total:

Rural:

☐ Forest	☐ Field	☐ Pasture	☐ Brush	☐ Roadside	☐ Barren Area	☐ Closed Building	☐ Open Building	☐ Other:

Urban/Suburban:

☐ Closed Building	☐ Open Building	☐ Vacant Lot	☐ Pavement	☐ Trash Container	☐ Other:

Aqiatioc Habitat:

☐ Pond	☐ Lake	☐ Creek	☐ Small River	☐ Irrigation Canal	☐ Ditch	☐ Gulf	☐ Swampy Area	☐ Drainage Ditch	☐ Salt Water	☐ Fresh Water
☐ Brackish Water	☐ Other:									

Exposure:

☐ Open Air	☐ Burial	Depth	Cloth-ing	☐ Entire	☐ Partial	☐ Nude	Portion of Body Clothed:
Description of Clothing:							
Description of Debris Covering Body:							

State of Decomposition:

☐ Fresh	☐ Bloat	☐ Active Decay	☐ Advance Decay	☐ Skeletonization	☐ Saponification	☐ Mummification	☐ Dismemberment

Evidence of Scavengers:

FIGURE 20.1 A form used to document general information concerning forensic entomology collection.

Forensic Entomology Larvae Collection – Log Sheet

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:		Date of Collection:
Specimens Collection By:		Agency:	State:	Country:

Sample Information

Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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Sample No:	Date/Time:	☐ Maggots	☐ Adult Flies	☐ Pupae	☐ Beetles	Collection Method:	☐ Aerial	☐ Hand	☐ Preserved	☐ Reared
☐ Body Surface	☐ Internal Organs	☐ Proximity (i.e. Body Bag)		Collected in 70% Ethanol:	☐ Yes ☐ No	Were Larvae Ever Placed in Cold Storage:	☐ Yes ☐ No	No. of Preserved Insects		No. of Live Insects
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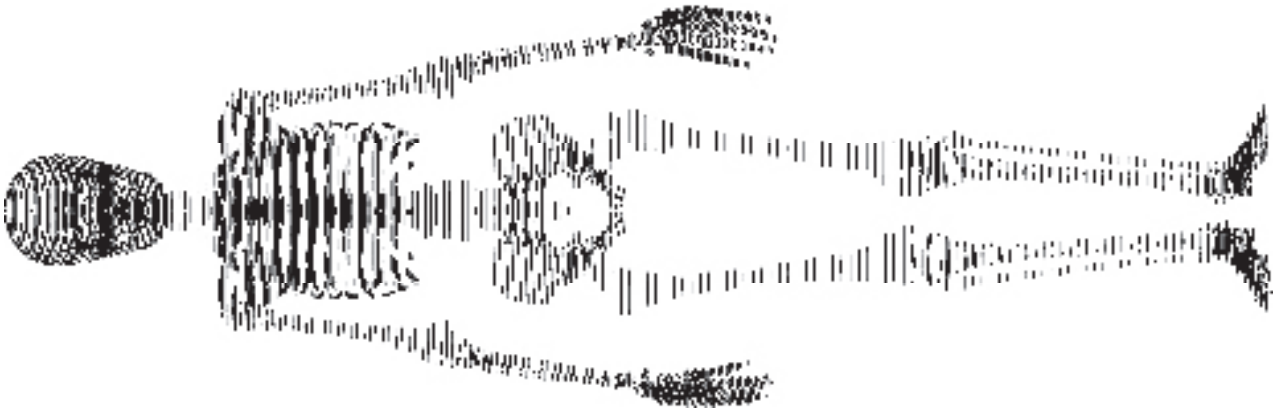
FIGURE 20.2 Forensic Entomology Larvae Collection Form: Log Sheet.

Forensic Entomology Larvae Collection Form – Scene

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:		Date of Collection:
Specimens Collected By:		Agency:	State:	County:

Possible Traumatic Injury Site (Comment or Draw Below):

Place Specimen No. (From Collection Log) on Location Where Specimen Was Collected



Forensic Entomology Larvae Collection Form - Morgue

Notes/Additional Information:

Insect Chain of Custody:

Insects Released To:	Date:	Agency:

FIGURE 20.3 A form used when examining and collecting forensic entomology larvae from a scene.

Forensic Entomology Larvae Collection – Temperature Data

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:		Date of Collection:
Specimens Collected By:		Agency:	State:	County:

Climate Control Devices:

Heat/AC:	☐ On	☐ Off	Heat/AC Setting: O	Ceiling Fan:	☐ On	☐ Off	☐ Other:

Scene Temperatures:

Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
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Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
Date and Time:	Ambient:	Ambient 1 ft:	Body Surface:	Ground Surface:	Under Body Interface:	Maggot Mass:	Soil Temp:	Soil 10 cm:	Soil 20 cm:	Daily Max:	Daily Min:
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FIGURE 20.4 Forensic Entomology Larvae Collection Form: Temperature Data.

Forensic Archaeology

Case/Incident No.:	Crime/Incident:	Location of Crime/Incident:		Date of Processing:
Location of Clandestine Grave:		Agency:	State:	County:

Manner of Death Information:

Manner Person Died:	Actual Location Person Died:	Date of Death:	Date of Burial	Position and Orientation of Body in Grave:	Methods Used Disguise Grave:

Aerial Site Maps:

Source of Map:	Date of Map:	Source of Map:	Date of Map:	Source of Map:	Date of Map:

Hydrogology Study:

Source of Study:	Date of Study:	Source of Map:	Date of Study:	Source of Study:	Date of Study:

Site Examination:

☐ False Color IR	Description:
☐ FLIR	Description:

Microtopography:

Descriptions of height and roughness of surface:

Soil Characteristics:

Describe soil Color in and Around Grave:

Vegetation:

Describe Vegetation and Pioneer Plants:

Soil and Vegetation Halo:

Describe Soil and Vegetation Halos:

Remote Sensing:

Describe All Remote Sensing Techniques Used:

Animal Activity:

Describe the Animal Activity around the Area of the Grave:

Exhumation Technique Used:

Describe the Exhumation Technique(s) Used:

FIGURE 20.5 Forensic Archaeology Form.

EXERCISES

This exercise requires some preplanning on the part of the instructor. Locate a secured area that will not be disturbed for approximately two months. Dig a large hole and bury a plastic skeleton in this hole. The two months will allow the vegetation and pioneer plants to grow.

EXERCISE 20.1

The exercise is to return to the remote location and then locate and exhume the buried remains. The students will be provided all the necessary tools, equipment, and forms necessary to perform the exercise.

PHOTO EXERCISE 4.29

Clandestine Graves

Photographer's Name:	Camera Make:		Camera Model:	Camera Serial No.:
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:
This exercise will be completed during the lecture on clandestine graves.

1. During a mock clandestine grave exhumation, properly document the scene using the previously taught techniques.
2. Pay attention to specifically document:
   a. The vegetation around the scene
   b. Any obviously visible evidence
   c. Any unnatural depressions
   d. Any visible halos
   e. The process of clearing the vegetation
   f. The site setup
   g. The exhumation process
   h. The completely exhumed grave pit

21 Fire Scenes

THE FIRE

A fire requires the combination of four components:

1. A fuel supply
2. Oxygen
3. A heat source
4. An uninhibited chemical reaction

For a fire or combustion to occur, there must be some form of chemical change in the fuel. For example, wood does not simply self-combust and burst into flame. First it must go through a chemical change. Application of heat to the wood causes it to change into a chemical fuel, transforming it from a source of potential energy into kinetic energy. A simple lighted match may not be enough to convert wood into kinetic energy, although it likely would suffice for a piece of paper. Fires generally progress in an outward manner both horizontally and vertically, although complicated fire scenes may differ from this simple scenario.

FIRE PROGRESSION STAGES

The fire will progress in four stages:

1. *Incipient phase*: This is the earliest phase. The length is dependent upon (a) the area of origin, (b) the fuel load, and (c) the use of accelerants (if any).
2. *Emergent smoldering phase*: The products of combustion (flames) become increasingly visible.
3. *Free-burning phase*: The rate and intensity of the fire rapidly increases.
4. *Oxygen-regulated smoldering phase*: During this phase, the oxygen is depleted, reducing the flames to more of a glowing type of combustion. This phase is where most of the gases and smoke are produced. As the fire continues to smolder, superheated gases continue to be produced. A new supply of oxygen would return this phase to the free-burning phase.

FIRE INVESTIGATION TERMINOLOGY

Accelerant is an agent, often an ignitable liquid, used to initiate a fire or increase the rate of growth or spread of the fire. The most common accelerants are still petroleum-based liquids such as gasoline and charcoal lighter fluids. Less common are fabric-softener dryer sheets and potato chips, among others.

Area of origin is the room or area where a fire began. The area of origin can be as specific as the investigator can define without the scientific challenges in the courtroom. This must be supported by burn-pattern analysis.

Cause (fire cause) includes the circumstances, conditions, or agents that bring together a fuel, ignition source, and oxidizer (such as air or oxygen), resulting in a fire or a combustion explosion. Stated in everyday language, the cause is how the fire started and/or how it was set.

Combustion products are heat, gases, solid particulates, and liquid aerosols produced by burning, e.g., the smoke, heat, and steam created by fire.

Conduction is the transference of heat through direct contact.

Convection is the transference of heat via a circulating medium such as air or a liquid.

Drop down is the spread of fire by the dropping down or falling of burning materials. This is sometimes referred to as *fall down*.

Fuel load is the total quantity of combustible contents of a building, space, or fire area.

Ignition source describes how the fire started.

Lines of demarcation are the burn patterns that form when smoke, heat, and flames are in contact with burning materials. There is a distinct division between burned and unburned materials.

Point of origin is the exact physical location where a heat source and a fuel come in contact with each other and a fire begins. This term is generally avoided by most investigators. The exact point in time and space that combustion initiates can be quite difficult if not impossible to identify. This term is a possible legal land mine in the courtroom, as it suggests that one can scientifically pinpoint the exact point of origin for a given fire.

Radiant heat is the heat energy carried by electromagnetic waves; radiant heat increases the temperature of any substance capable of absorbing the radiation. Radiant heat is a critical component to the spread and growth of fire intensity.

BURN PATTERNS AND INDICATORS

These are generated directly by fire plumes and combustion heat. They are used to determine fire development and spread. While there are numerous different patterns, the most likely

to be encountered in small incidents are V patterns, inverted cone patterns, and lines of demarcation, among others.

V patterns: These burn patterns are caused when hot gases and smoke rise from a fire. As the smoke rises, it becomes progressively wider forming a "V". They roughly correlate to the locations of burning fuels. The lateral spread of the lines is primarily due to radiant heat from above as well as the upward and outward movement of the hot gases. The wider the angle of the "V" indicates a longer burning period of the materials that have been subjected to heat.

Inverted cone patterns: This burn pattern is a pattern generally the result of a short lived fire that burns out prior to reaching the fully evolved flame plumes. Some believe this type of pattern is the direct result of the use of an accelerant.

Hourglass pattern: This is a double V-shaped pattern. The traditional V pattern is caused by the plumes of hot gases. The bottom V pattern is caused by radiant heat on vertical surfaces that are more distant from the heat source than the surface containing the traditional V pattern.

Horizontal lines of demarcation: This pattern occurs when smoke, heat, and flames are in contact with burning materials. During the initial phases, the horizontal lines of demarcation will be high. As the fire continues, the horizontal lines of demarcation will be progressively lower.

Irregular, curved, or pool-shaped patterns: This burn pattern is generally indicative of the use of an accelerant. These should be considered to be areas that require further visual investigation. Other reasons for this type of pattern may include radiant heat, flaming smoldering debris, melted plastics, and ignitable liquids.

Fingers: Accelerants used on wood flooring may show "fingers" where the burning follows the cracks in the flooring.

ARSON ACCELERANTS

These are chemicals used to accelerate a fire. The range of accelerants spans a wide variety of compounds, although petroleum products are the most common. Collect evidence and place in a clean, unused 1-gallon paint can. Fill the can no more than half full and then seal the lid. Place the sealed can in a paper sack and then seal the paper sack.

DOCUMENTING A FIRE SCENE

As with any crime scene, the goal is to accurately document the investigation. At a minimum, photographs depicting the area of origin as close to the point of origin as possible are required. Overall photographs showing fire development and travel are also necessary. Remember that the structure or burned item is the scene, and the damage sustained is the evidence of the crime. It may be beneficial to think of the house as a person and the burn patterns as wounds.

Document the fire's area of origin. Document damage created by the fire. Document the burn-pattern evidence to identify the area of origin as well as to show the fire's development and travel. If there is any doubt, call the investigator to the scene.

EXERCISES

EXERCISE 21.1

The students will properly document accelerants.

Accelerant:

Accelerant:

Accelerant:

Accelerant:

PHOTO EXERCISE 4.30

Alternate Light Source: Fire Scenes Accelerants

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

This exercise will only be done in a safe, well-ventilated area, such as a vent hood.

Directions:

1. Place the camera on a tripod.
2. Set the camera to aperture.
3. Position the camera over a pan containing paper or pieces of cloth.
4. Pour an accelerant in a pan containing paper or pieces of cloth.
5. Using a 350-nm UV light, photograph clothing or other fabrics saturated in petroleum products.

22 Exercises for Questioned Document Evidence

IMPORTANCE OF QUESTIONED DOCUMENT EXAMINATIONS

A questioned document is a document where the origin or authenticity is suspect. It may be a paper or written on walls, doors, windows, etc. Important facts in a case can be determined by identifying who wrote the document and by examining forged documents. Handle all documents and related items as delicately as possible while wearing gloves. Place document between two pieces of cardboard or heavy cardstock. Devices are collected and placed in paper sacks or boxes.

Some other critical considerations and types of evidence can include:

Ink comparison: Documents are often forged using the same color inks as the original document. Forgers often fail to take into account that inks absorb and reflect light in different regions of the IR spectrum. The composition of the actual inks can be chemically analyzed for dyes in solvents. This is a destructive process.

Ink-line striae: The tip of the writing instrument has imperfections. These imperfections are transferred onto the document. These can examined under a microscope.

Indented writings: When a document is written, the pressure of writing causes indentations on the underlying papers. Examine trashcans and other areas for discarded paper. Examine the papers for indentation impressions from writing, as they may contain valuable information.

Printers and typewriters: These may contain valuable information. Old ribbons may contain typed information. Ribbons and font balls may also be significant in linking a document to a specific machine. Laser and ink-jet printers may be distinguished from one another, but computer printers are much more difficult to link to a specific document.

Photocopier and photocopies: The photocopying process may leave marks on the paper. It may be possible to link a particular machine to a specific document, provided that the machine is recovered. Documents are often forged and then photocopied. The document may show signs of photocopying, such as misalignment or incorrect spacing.

Photocopies or facsimiles: It may be possible to match the document to the machine used to fax the document. It may be possible to determine the make, model, and serial number of the machine. This information may lead to a business that has videos, which may have recorded the suspect.

Paper size, thickness, and opacity: Papers are not all made the same. The analyst may compare a document to known paper sources at the scene for similarities.

Watermarks: Some documents contain watermarks, which may be useful in determining the origin of the paper. Some companies keep records about the various watermarks and when they were changed.

Charred documents: The fact that a document is charred does not mean the document is useless. Collect charred documents and place them between two layers of cotton in a sturdy container.

Obliterated writing: When mistakes are made while writing a document, the words or information not meant for the document may be obliterated. It is often possible to extract information from these obliterations.

Erasures: This is similar to obliterated writings. The eraser may remove the ink or pencil, but the writing may still be visible in the UV and/or IR range.

Physiological aspect: When individuals write a document, they write them with their mannerisms, that is, masculine versus feminine.

Common types of nongenuine signatures: Signatures provide the best evidence to link a document to a specific person. Methods used to disguise a signature include (a) tracing (b) copying, (c) drawing, and (d) freehand approximation.

Graphic arts: Artwork, negatives, plates, or office printing may be linked back to the originator of the art. These may be useful in determining who purchased the art.

Age of a document: It may be possible to document the earliest date a document could have been created. This would be useful in determining whether a document was created long after the original, i.e., documents that are presented to be older than they actually are.

Check writers: These devices are used to mechanically write checks, generally done through an embossing process. It may be possible to determine the make or brand of the check-writer that was used.

Embossing and seals: Embossed or sealed impressions may be compared to a known source, which may have identifiable characteristics.

Rubber stamps: The repetitive use of a stamp may create imperfections that are useful in linking the stamped document to a known stamp.

Plastic bags: Plastic bags in a roll may be compared to a bag that has been removed. It may be possible to link the plastic bag to a specific roll.

EXERCISES

EXERCISE 22.1

Create an indented writing sample by writing a note on several stacked pieces of paper.

Description of the article

Description of the article

Description of the article

PHOTO EXERCISE 4.31

Questioned Documents

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

1. Write a note on the top page of several pieces of paper, pressing hard to leave indented writing on all the other pages.
2. Using oblique lighting, photograph the indented writing.

Section VI

Putting It Together

23 Processing Methodology Exercises

Most crime scenes will ultimately be processed in generally the same manner, i.e., they will be photographed; a sketch may be created; evidence will be collected, processed, packaged, and submitted; and a report or reports will be generated to document what was done. The processing of a crime scene is not the time or place to be learning or practicing new techniques, which is what the investigator's downtime should be used for. It is, however, the time and place to determine what techniques are necessary and who will carry out these tasks.

In very brief detail, here is the sequence of the process methodology:

Initial call: This is where the scene processing actually begins. Identify the need for additional equipment, additional manpower, etc.

Initial briefing: Verify that the initial information has not changed. Receive any additional or new information. Identify the relevant legal authority to process the scene. What is the legal authority for a search warrant, consent, open field, etc.? What is the scope of the consent or warrant?

Initial observations: Make your initial observations at this time. Look at the entire scene prior to beginning the processing.

Develop a flexible processing plan: Crime scenes should never be processed off the cuff. There must be a dialog between the detectives and the crime scene investigators. Most scenes will generally be processed in basically the same format. Nevertheless, there are instances where a detective may have additional information that could lead the processing in other areas of the scene. Define what each crime scene investigator's duties are. Define "how" the scene is to be processed. In all cases, the scene must be processed in a logical format. Ensure that the evidence is properly documented and collected. Determine which crime scene investigator will be performing what duties. Eliminate the guesswork and assumptions

Overall photographs: Document the overall scene as you found it. This should be done prior to *any* detectives or other investigators entering the scene.

Initial or primary search: The initial search is limited to what may be seen using normal lighting or the use of a flashlight. Nothing is moved or altered at this point. Consider using an alternate light source to identify areas of evidence that are not visible to the naked eye.

Midrange and close-up photographs: All evidence identified during the initial or primary search is photographed using midrange and close-up photographs. Take these photographs in pairs.

Sketching: Initiate the sketching process. The initial observations will provide valuable information as to what needs to be sketched in detail and what does not.

Notes: Throughout the scene processing, periodically stop and update your notes. Do not simply rely on the photographs.

Mark and identify obviously visible evidence: This is the time to place the markers next to the evidence. Update the sketches with the evidence information and pertinent measurements.

Midrange and close-up photographs: This is the second set of midrange and close-up photographs. The first set was without the evidence markers. The second set is with the evidence markers in place.

Deal with the deceased: Once the visible evidence has been documented, deal with the deceased. The area must be processed prior to the coroner or medical examiner to ensure that no evidence is lost or destroyed during the removal of the body. Unfortunately, this may take some time.

Collect initial evidence: Properly collect the evidence. Properly package the evidence. Properly secure the evidence in a transport vehicle.

Second search: This is a more progressively intrusive search. Here the search involves moving furniture and other things in the scene. Items are moved only after they have been properly documented. If a detailed examination of an item must take place, do the examination prior to moving the item. Collect DNA swabs at this point as well.

Third search: Apply labels and scales to document bloodstains and bullet defects. This is the time to document bloodstains, the shooting scene, etc.

Fourth search: This search is where the investigators will process for latent fingerprints and/or chemical enhancements.

Fifth search: This is the most intrusive search of all. It involves carpet cuttings, furniture/bed cuttings, and cut-open walls.

Additional searches: The total number of searches conducted is scene dependent. Take as many searches as you feel necessary.

On-scene debriefing: This is the time to compare notes with the scene detectives and other investigators. Go through the scene room by room and discuss what was processed, collected, documented, etc.

Final walk-through: This is the time to ensure that (a) all equipment has been collected, (b) all evidence has been collected, and (c) all evidence has been secured in a transport vehicle. I create a decontamination bag, and I put the evidence markers in this bag. During the final walk-through, compare the total number of evidence markers to the number of evidence items in the transport vehicle to ensure that all the evidence is actually in there.

Release the scene: Once the scene has been properly processed and all evidence has been collected and properly stored for transport, release the scene. If there is a question as to whether or not further processing must be done, hold the scene longer. This only requires setting an officer to observe the scene.

Process the evidence in the lab: Once back in the lab, complete any further processing of the evidence, such as photographs, swabs, fingerprints, etc.

Properly package the evidence: Once the evidence has been properly processed, package the evidence in appropriate packages. Seal the evidence packages. Consider using a convenience container for similar items or items collected from the same area.

Properly submit the evidence: Once the evidence has been packaged and sealed, submit the evidence to the proper holding areas such as a property room, a property management unit, an evidence locker, a serology unit, a drug lab, etc.

Complete the final sketches: If computer-generated sketches are to be completed, this is the time to do so.

Complete the final reports: All reports are to be completed and properly submitted. This is the time for a technical review of very detailed technical-type reports.

Formal debriefing: Large scenes involve multiple agencies or simply are very heinous in nature. A formal debriefings may assist in working out issues and dealing with this situation.

EXERCISES

MOCK CRIME SCENE

This exercise will test your knowledge of what you have learned throughout the course. You will be provided a scenario of a mock crime scene. You and your team will properly process the scene. You will be provided all the sample forms and equipment necessary to process the scene. Note that you may not need all the forms and all the equipment provided.

EXERCISE 23.1

Mock Crime Scene

PHOTO EXERCISE 4.32

Mock Crime Scene

Photographer's Name:	**Camera Make:**		**Camera Model:**	**Camera Serial No.:**
Camera Mode: Aperture Priority	**Shutter Speed:** As Determined	**Aperture:** f/11	**ISO:** 100	**Focal Length:** Fill the Frame

Directions:

Utilize the techniques taught to properly photograph a mock crime scene.

24 Report-Writing Exercises

EXERCISE 24.1

Write a report based on the mock crime scene that was processed during Exercise 23.1

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ISBN: 978-1-4987-0142-6
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